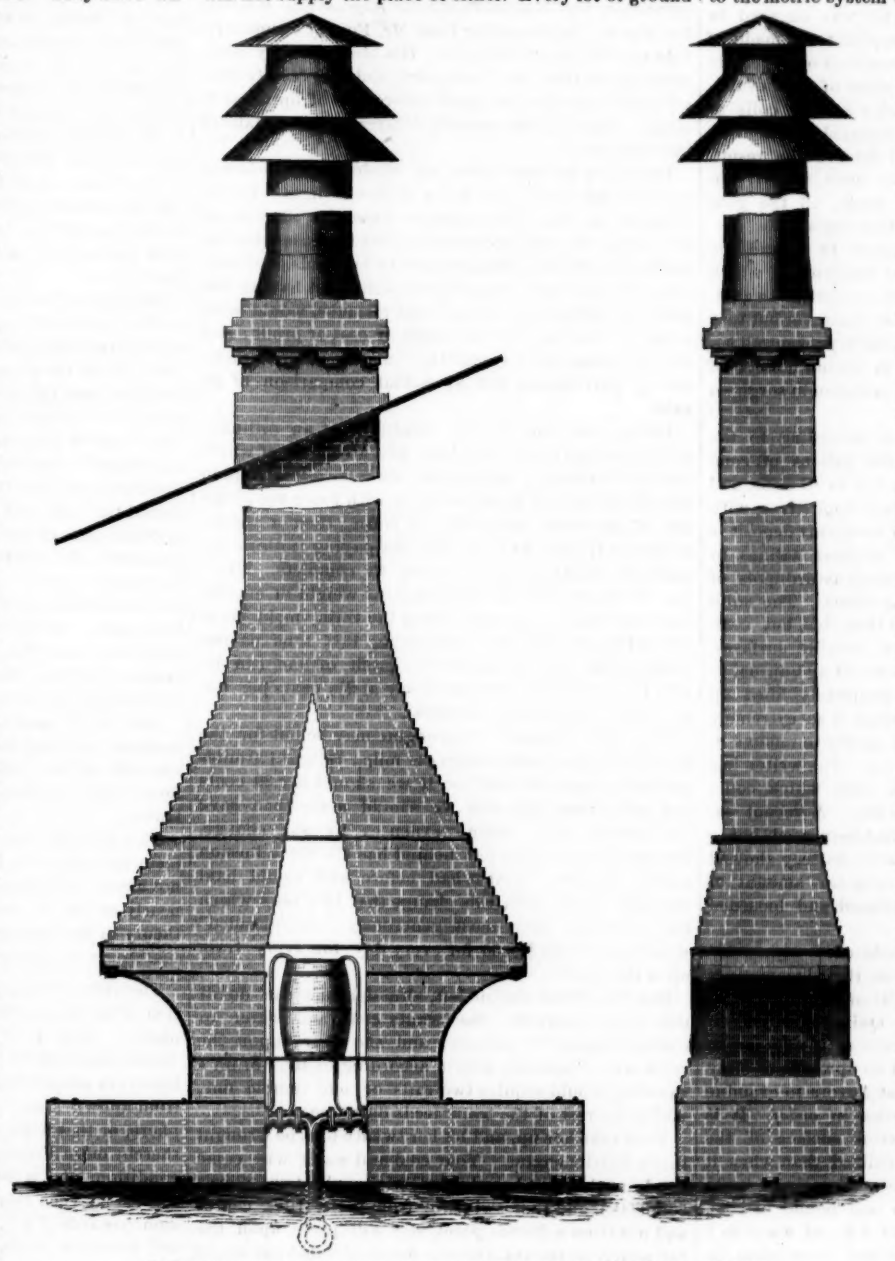
RAILROAD GAZETTE

SATURDAY, MAY 13, 1871.

BLACKSMITH FORGES.

The cut we give herewith represents a pair of blacksmiths' forges, such as are used in the Pennsylvania Railroad shops. There is no especial novelty about them, but they have much to recommend them in their convenience and proportions. As indicated by the cut, they are built of brick and faced with iron wherever the brick work is liable to be injured. They have water tuyeres which are made so as to circulate the water into the top of the barrel shown, and out at the bottom again by the pipes represented in the cut *P*. All the brick work is securely tied together by bolts and clamps, and the construction all through is of the very best character. The engraving is made on a scale of one quarter inch to one foot, and made accurately enough to take measurements from.



FORGES USED IN THE PENNSYLVANIA RAILROAD SHOPS.

New Rolling Mill of the Baltimore & Ohio Railroad.

This mill, which was commenced in October, 1869, has just been completed and put in operation. The ground plan of the mill is of an L form, and is 540 feet long and 100 feet wide. The wing represented by the base of the L is 340 feet long and 100 feet wide. Besides this portion of the building, on the back of the L there is a wing attached, 295x100 feet, so that altogether the building covers 108,500 square feet area, or nearly 2½ acres.

The puddling mill has twelve double puddling furnaces, three sets of rolls in the rail-train, and one "squeezer" attached. There are also three pairs of hot shears for cutting the iron, all driven by one double engine with cylinders 24x30 inches stroke, and a fly-wheel 30 feet in diameter and 40 tons in weight.

The steam for driving this and the rail-train engine is furnished by the locomotive boilers. In one of the wings is located a 5,000-lb. steam hammer for hammering a portion of the puddled iron. At the extreme end of the main building are the shears for cutting up the old rails, next to which are the two pairs of hot shears, and a train of rolls for making tops and bottoms, or preparing the iron for the rail rolls. Sixteen heating furnaces—eight of which are used for heating the tops and bottoms, and eight for heating rail piles—are located between the rolls referred to and the center of the main building, where the rail-train is placed. This is driven by another double engine of the same size as the one described.

The mill is also equipped with two saws, two blowers, two straightening presses, and two pounding machines, all driven by an engine with cylinders 20 inches in diameter and 4 feet stroke. All the engines are supplied with steam from five locomotive boilers which are separate from the furnaces, thus dispensing with the steam pipes over head and the boilers over the furnaces. The blast-pipe is under ground.

The straightening presses are arranged two feet below the hot bed, so that it is not necessary to raise the rails above the bed in moving them to the presses. This saves a good deal of labor.

The rails are shipped from the end of the 240 feet wing on cars, the track for which is six feet lower than the grade of the building.

The mill is capable of manufacturing 100 tons of rails in from ten to twelve hours.

—E. C. Murphy has been appointed Superintendent of the Chicago, Cincinnati & Louisville Railroad in place of Thomas Payne.

The Metric System.

Prof. Chas. E. Davies, of West Point, delivered a lecture at the Cooper Institute, on the 29th ult., on the metric system and the probable consequence of its introduction into this country. After explaining the system in detail, he concluded his remarks as follows:

Let us suppose the metric system to be adopted by law, and every other system excluded—for, without such exclusion, the whole thing would be a perplexity and a farce. What follows? We have blotted out from the mind of the nation the foot and all knowledge of every measure into which it enters, as a unit. We have expunged the yard, used in connection with the arm, more or less, in every family; and the pace, the unit and guide of the farmer for an approximate measure that will not supply the place of either. Every lot of ground 25 feet front by 100 feet deep must be described as follows; 7 meters, 6 decimeters and 2 centimeters front, by 30 meters, 4 decimeters and 3 centimeters deep. Thus, the description of every such lot will require three difierent units and six words, instead of one unit and two words. In all conveyances and descriptions of land, the translation from one language to the other would occasion great trouble and difficulty. The old familiar mile of 1,760 paces is also gone; and the distance from Albany to New York, 145 miles, will be known to us, if known at all, as 229,680 meters. Let us see how we shall recognize the earth in its new dimensions. Its diameter, instead of 8,000 miles in round numbers, will be 12,672,000 meters, and its circumference about 39,810,355 meters and 2 decimeters. The acre is also gone, and with it all its multiples and submultiples. Since the commencement of the present century the public lands have been surveyed and laid out in townships of 6 miles square, each containing, of course, 36 square miles, or 23,040 acres. The side of each township, by the new system, would contain 9,504 meters (instead of 6 miles), and its area 921,600 *ares*. All the lands from the Ohio River to the Pacific Ocean have been surveyed, deeded and recorded in the units of the square mile and the acre. What will be the labor and the confusion of translating every deed and every record into the language of the meter and the are? We should scarcely know our own farms by their new names.

If the introduction of the metric system produced only a change in the names of the units, leaving their values the same, or, if it altered the values only, preserving their names, the difficulty would be comparatively small. But, unfortunately, we must change both ideas and words—the foundations of systems and the language by means of which these systems are developed and made known. These double changes, made at the same time, are very serious, because there is no thought or word in one language having an exact synonym in the other. The consequence of these changes to the metric system would be the following:

1. They would strike out from the English language every word and phrase and sentence used in connection with our present units of weights and measures, and would impose the necessity of learning a new language for the one now in use.

2. They would blot out from the knowledge of the nation all apprehensions of distance, and area, and volume, acquired through the present units, and would render necessary the acquirement of similar knowledge by less convenient units, having different relations to each other, and expressed in a new and unknown language.

3. They would change the records of our entire landed property, requiring them all to be translated into a new and foreign language.

4. We must not forget that prices and currency are dependent upon, and necessarily adjust themselves to, weights and measures, and that all our ideas of cost and value are fixed with reference to our present units. The adoption of the metric system, therefore, would carry with it an entire change in the money values of all articles of commerce and manufactures, and of all agricultural productions; for these values would have to be readjusted to the new units, and to be expressed in the new language. Hence the changes would extinguish all knowledge of money values, now so familiar to the entire population in their daily purchases, and sales and barters, for those values are all adjusted with reference to the units of weights and measures.

5. Can we afford to make these changes for the very small gain of changing our present yard from 36 inches to 39 inches and 37-100 of an inch? Can we accept any system as a substitute for the one now in use, unless it makes some provision for retaining the unit 1 foot.

All our knowledge of distances, the yard, the rod, the furlong, the mile, the league, come from it. The square rod or perch, the rood, the acre, are also derived from it. Can we change the survey of an entire continent, with the description of every piece of land upon it, from the unit, one acre, to the unit, one are, forty times less? Can we change, without great confusion, the unit of volume, the cubic foot, and the cubic yard, so familiar to every school-boy? and, above all, can we change our unit of weight, the pound avoirdupois, which is equal in weight to sixteen of the one thousand equal parts of a cubic foot of rain-water?

6. Can we abandon, as a mere question of language, these short, sharp, Saxon words, for their equivalents expressed in a foreign language? Besides, the foreign language which we introduce has no exact equivalents to these words, which have almost become things, and which now form a part of the mind and knowledge of every people who speak the English tongue, or are connected with the American commerce. These are the great questions now discussed and considered by the American people. They affect directly the interests of all classes. They affect our systems of public instruction, our trade, our commerce, and the mechanic

arts, in all their development, and in all their applications. Let us, then, approach these questions with a deep sense of their importance. Let no hurried action embarass us. Let us remember that time is a necessary element in the accomplishment of everything that is truly great, and that these questions can only be rightly and permanently settled by the enlightened and aggregated judgment of mankind. Let the discussion, therefore, be full and complete.

Contributions.

THE CONSERVATIVE FORCES OF NATURE—BOILER SCALE, OR INCRUSTATION.

A number of years ago a telegraph operator was visiting a country acquaintance who was engaged in making sorghum syrup. Great complaint was made of the annoyance caused by the incrustation of vegetable gum deposited on the bottom and sides of the evaporator. The idea struck him to make several coils of wire round the pan, already well insulated in the brick furnace, attach a battery to it, and observe the result. To the great satisfaction of those most directly interested, no deposit whatever was made, all the gum being then skimmed off with the other impurities.

This result led the experiment maker to extend his researches to steam boilers, several hundred of which have been tested in a manner which has satisfied a number of persons that there is no doubt whatever but that electro magnetism is a certain specific to prevent all accumulation of calcareous salines in steam boilers of all sorts, even extending to the incrustation in sorghum and salt pans.

If a locomotive in constant use, according to the usual estimate, evaporates daily 3,000 gallons of common water, largely impregnated as it is in all wells, and even in Lake Michigan and the Mississippi River, with carbonate and sulphate of lime, an enormous deposit is rapidly accumulated. Ten grains of these salines to the gallon make no less than 39 pounds avoirdupois of 16 ounces each, of 480 grains to the ounce. The solid matter in water is even much more than this, but comparatively little of it adheres to hot metallic surfaces, being blown off as soft mud. It is not at all unusual to find the spaces between the flues completely filled up with incrustation, which in many cases is so extremely hard as to require the most violent means to remove it, the boiler being often taken to pieces. The writer has seen locomotive flues covered with scale which could only be removed with a new sharp file. A recent examination of a locomotive which had been used but a few months after the attachment of the battery showed that scale of all degrees of hardness to the amount of several wheel-barrow-loads was softened and loosened so that it could be washed out.

Samples of these are herewith inclosed.

The results of a lengthy trial on their locomotives and steam ferry boilers on the Mississippi River induced the Chicago, Burlington & Quincy Railroad to purchase the patent, and this railway is now understood to have the batteries applied to upwards of sixty engines. An expert is stationed at Aurora to examine the engines and keep the batteries in order. It is claimed that by its use the interior surface of the boiler is even cleaner and less oxidized than when it was new; that a boiler will evaporate nearly or quite its maximum of 7 lbs. of water to one pound of coal, never going down to the average of 4 lbs. of water to 1 of fuel; that the saving in fuel and consequent increase of power being thus large, the vitality of fiber of the iron in the flues and fire-boxes is never destroyed by the intense heat necessary to penetrate the incrustations of foul boilers. A sheet from the most exposed locality, where it had been most fully tested, was taken out at Aurora and pronounced to be even tougher and more ductile than when it was new. A piece from a boiler which had no battery on it was as brittle as a china dish. It would be interesting to hear from the Aurora shops and ascertain, for the public good, whether these strong claims have any foundation in fact.

Other great results, beyond the prevention of boiler scale, are claimed for electro-magnetism. It is insisted that every iron bar which stands up in a warehouse becomes more or less completely magnetized according to the time it remains in that position. One end is made positive, while the other is negative. This may be proved, even on a common round coal stove, by testing with a little watch-seal or other reliable compass. When it is desired to weld two bars of iron together, if their magnetic condition is correct, they will naturally run together with the most perfect affinity, and the weld is at once complete. But two positives, or their opposites, will not weld at all! Can there be any truth in these statements? Does the experience of any of your readers prove or refute these assertions? They are only thrown out here as hints to excite the curiosity and observation of those engaged in working in iron, which prompt investigation and may finally show to them that—to modify Shakspeare for our purpose—"There are more things in earth than are dreamed of in our philosophy."

THE FAIRLIE LOCOMOTIVE.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The number of the RAILROAD GAZETTE for April 8 contains a very interesting and fair article by Mr. Forney, read before the Practical Engineers' Association, relative to locomotives and their action upon the track, in which he has criticised an article written by me, and printed in *Van Nostrand's Eclectic Engineering Magazine* for March. In dissenting from Mr. Forney's summary, I do so with great diffidence. His ideas are very clear, when taken from his stand-point, and it is readily conceivable to me that our great divergence of opinions is simply caused by the entirely different view we take of the same matter.

Indeed, in his first clause, the whole difference is that we show the same fact by a different light. But it seems to me that these matters which we discuss are interesting not only to ourselves, but to those who, unprofessionally, have their money in railroads, and who, whatever be their learning or ability, not having the habit of reading percentage and formulæ, would wish rather to see the facts in simple of cost or profit; and that we should try to make these matters plain to them, not by percentage, but by actual comparison of results.

Let us now consider the condition of an ordinary train upon the track. We have first an engine of which one-third is useless weight, the other two-thirds upon wheels which bear upon the track with twice the pressure of any other wheels in the train; then a tender weighing 17 tons to be hauled, but paying nothing towards its haulage; next, 25 cars, to complete. *Now lop off the 10 tons one-third useless weight of engine, then take the 17-ton tender from the train, mold them into a 13½-ton freight car carrying 13½ tons paying load, and we have increased the profit of one run by 13½ tons, which for 120 miles, say at 2½ cents per ton per mile, is equal in all to $40.50.

The daily expenses of an engine may be put for the immediate future at 25 cents per mile; this, at 120 miles per day, is equal to $30; or, if we should say 30 cents per mile, then $36, and we should more than save the present daily engine expenses by our change. For the 20-ton engine left behind has all the adhesion and all the power that it had before, and would haul the same load; with this change that 13½ tons which for years has been most generously "dead-headed" would pay about $40.50 for every day for every train upon the track.

But the 20-ton engine left, although she can do all this, is not complete. She wants coal and water to continue upon her journey, and she bears upon the track with a pressure which, according to Mr. Forney's showing, would require two rails or one double one, whilst the rest of the train needs only one.

Then take her up, and let her twenty tons be wrought into a Fairlie engine. Your coal and water will come handy to the foot-board; and with only two wheels connected, and they swiveling from their truck center and not from a distant point, she will press upon the rail nearly as the train does. An overloaded car would exceed, an underloaded one fall below.

This will allow you to buy your iron for the "work done" and not for the arbitrary standard of "extra weight" on driving-wheels. For at this time, when the purchase of rails is falling like a heavy scourge upon our railroad companies, it is useless, nay it is positively cruel, either to talk of increasing the weight or discouraging its decrease, and thus doubling the tax for every mile in the country. It would be a hard thing, even if it were necessary; but it has been shown above not to be necessary. It would be hard if it were useful, but the attempt will be made to show that it would not even answer its intended purpose.

A rail laid from one tie to another is not simply a beam to support a given load over that distance, nor is it in the condition of a bridge constructed to carry moving loads. In each of these cases, we have only to do with the strain per square inch possible to come upon the structure and the resistance of the material in compression, tension, etc., per square inch to give the requisite strength. But in this case we attack the material itself; we strike directly at the integrity of the iron, and our profession requires us to examine the nature of the material and the best means by which the most use can be made of it with the least possible detriment. Rails that break are bad rails, and we are not now discussing bad rails. Rails that wear out do so in natural course, and we do not complain of fair wearing. What we wish to get at is the effect of pressure in various magnitudes, and practically to know what changes are made by different weights, in destroying the inherent character of the material.

*Figures of weight and train as given by Mr. Forney have been adopted as the basis in this article.

Of course Mr. Forney does not suppose that his double-rail, although it might prove satisfactory as regards the strains, would do to run on. But from this point his suggestions are, as I shall attempt to show, intrinsically wrong. Could we adopt the "rail of double weight" and at the same time increase the surface of contact on top and side, we should arrive close at our mark. But experience has shown us that the rail must have a rounded head, and therefore as the wheel has more than a mathematical point of tangent contact with the rail only on account of the yielding of material, it follows that two wheels, each rigid in proportion to their weights and heights upon a track rigid in proportion to their weights, will bear precisely or nearly upon the same surface, whatever their weights may be.

This brings us to the point. Having a certain quantity of surface, what will be the difference in the effects of the several weights upon it? To discuss the question we must for a time depart widely from our subject.

In Lyell's Elements of Geology (edition of 1841), the author speculates upon the causes of slaty cleavage—as to its being formed by chemical or polar action. Years after the physicists found out the real cause in pressure, and this law was then enunciated, proved and received: "that material laminates under great "pressure in planes perpendicular to the direction of "pressure." An Italian gentleman, some years ago, in describing to me the manufacture of macaroni, mentioned the same fact as characteristic of the dough at a peculiar part of the process when it undergoes great pressure. He said that it always became laminated in horizontal planes—the pressure being vertical—and flake after flake could be lifted off from the mass and laid aside. In experiments made by Tyndall on ice, white wax and clay, the same law obtained. Ice even laminated across the planes of freezing, though with greater difficulty than coincident with those planes.

As a law it is general. It is practical for all ductile matters, and only unpractical for granular matter because from its conformation it crushes into grains before a sufficient force can be brought to produce the laminæ.

This law has received careful and elaborate treatment from Prof. J. D. Dana, of New Haven, and I am not afraid to trespass on time in giving in substance as nearly as can be remembered his beautiful molecular theory of the phenomenon:

——> *a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p.*
——> *a b c d e f g h i j k l m n o p.*

The arrow above is supposed to represent the direction of the force, and the letters to stand for atoms of matter. Now if *a b c d* are forced closer together their atomic atmosphere becomes condensed, and of course heated in proportion to the force used. This causes—from known laws—an expansion of the nearest atmosphere, or that between *d* and *e*, which two atoms are thereby more disconnected than was before their normal condition, and a separation or repulsion is therefore formed between them, and *e*, being forced by the expansion towards *f g h*, unites with them, causing by the self same law another separation between *h* and *i*. It is in this way, as nearly as I can remember, that he particularly accounts for crystalline cleavage, with an understanding of the general law. Of course the four atoms used above is a mere matter of convenience. The number would vary with the material, the force, and many other causes, and would always be great.

Now the damage which was referred to in my article was not to the breaking of rails, nor to their superficial disintegration, but to their being torn into ribbons (laminæ), and I have for some time past looked to the operation of the above law as the true cause of their anomalous destruction.

The difficulty is (whatever be the cause) that the same work which should only wear off a small portion of the rail-head, if its effects were superficial, actually creates a disease at some distance below the surface, spoiling the cohesion of the iron there, and rendering the intermediate strata useless—a sliver, a ribbon, or what you will; so that an amount of iron which it would have required years to wear away by the natural progress of abrasion is lost at a single blow. This force may be vertical or horizontal, and Baron von Weber has told us what the horizontal forces are. This theory, too, accounts for the difference which we find between the wearing of the rail and of the wheels; for the wheel,

having a tread of steel, cannot be liable to this detriment, since, from its more granular character, it would have the point of laminating pressure much above the more ductile, fibrous wrought iron, and would therefore wear down by abrasion, and not by coming off in pieces, as the latter does.

Treating the law above stated generally, we may suppose that each material, and each quality of the same material, has an appointed amount of pressure at which lamination is decided and permanent. Long before that, as we may judge from analogy, the effect is temporarily produced; but a relief from the pressure then leaves the metal to a natural process of annealing. But when this certain point of pressure has been reached, or the continued repetition of some certain point of pressure bordering on the limits of elasticity has occurred, the laminæ is decided, the actual separation is produced, and our former solid body is a body with a shell on it, which needs but another force to break it off, as we see along our railroads every day. If this reasoning be correct, it is plainly evident that with the same cohesion of material, a 34-lb. rail would be much less injured by a 2½-ton wheel than a 68-lb. rail would be by a 5-ton wheel.

Mr. Forney is correct when he says that we cannot accurately estimate the effects of different weights upon the track. But we do know that when engines were half as heavy as they are now, no such effect as this occurred. Then track was simply worn. It would be strange to find that civilization had created a disease in iron, its best servant, just as it has created many diseases in the human body, by crowding too heavily the extra work required. For from the known operations of the above law, there is some point back of which the running of trains would cease to laminate, and only continue to abrade. And this is the point we are bound to arrive at; for railroad companies can afford to renew the iron which is worn out in service, but they find it hard to relay that which is torn into fragments, only to have the new torn into fragments by the same continued unnatural cause.

But some exception must be taken to Mr. Forney's remark that, "Up to the present time, the great majority of American railroad engineers have decided "that the former," (*i. e.*, increasing the weight of the rails rather than the number of wheels) "is the cheaper of "the two." They have only done so as regards the 3 and 4-coupled wheels of the locomotive now in vogue upon our mountain roads. My article was on the Fairlie engine, which multiplies wheels on a very different principle, and is diametrically opposed to the long wheel-base of those engines, and therefore this judgment militates none against it. Broadhorns were the best boats on the Mississippi River up to the time of Fulton, but afterwards they were discontinued. Horses were quite sufficient for cars up to the time of Stephenson and Ericsson; then the locomotive came into use. But Stephenson's "Rocket" and Ericsson's "Novelty" were but as grass-hoppers compared with the modern locomotive.

From Stephenson and Ericsson the change has been wondrous. English and American engines have both done well, but unfortunately, from the very necessity caused by the immense increase of business and competition, the successive improvements have all been in one direction. The unbalanced excessin that direction has brought the engine to a state where it becomes dangerous to the iron path made to carry it. There is no need that we go back one iota. But while we maintain the full power, let us turn its unruliness into docility. We are not the "slaves of the locomotive," that we should be obliged to double the cost of the track on account of its imperfections. Rather it is our servant. Can we not use it, yet keep it within reasonable bounds?

And it seems to me that reasonable bounds are these: that it should employ all its force consistent with natural laws upon its work—in other words that 27-47th of it should not be "dead-headed"; that it should do no more damage to the track than paying load on the same number of wheels; that it should run around any curve that paying load can be carried around, and with as much speed and safety. The locomotive is our servant; the paying load our master. Surely we should not yield more to the first than to the second.

I have recommended a fair trial of the Fairlie engine, because it claims to do just this, and because authenticated accounts yield to the claims. If these accounts are mainly reliable, we have the following results:

30-ton ordinary engine hauls 17-ton tender and 25 cars in train.	20-ton Fairlie engine hauls 28½ cars in train.
10 tons lost from utility.	No weight lost.
Weighs at rest 5 tons per wheel.	Weighs at rest 2½ to 3 tons per wheel according to the amount of water and coal.
Is unbalanced, leaving 10 tons at one end, 20 tons at the other.	Is balanced; about 10 tons at each end.
Frequently plunges heavily from want of balance, with immense detriment to track from the increased weight thrown upon single wheels over the 5 tons of normal weight.	Being balanced, does not plunge, but runs with a motion and steadiness so soft as to have attracted general attention to the fact from all who have ridden on one.

Surely such results are worthy of notice and fair trial.

I am not the judge, but an advocate in the case; yet I may say that no misconception exists in regard to the damage which the rigidity of the wheel-base in the ordinary engine does to the track. The "truck" has been invented and is daily improved, on the judgment of American engineers that it not only runs more easily around curves but obviates the dangers of uneven track better than rigid wheels. From this cause it has been placed under our passenger and freight cars, and from this reason set under the front end of our locomotive. Mr. Fairlie puts it under both ends, as we have done under all the rest of our stock.

As we pass along most of the railroads of the country, we find great slivers torn from the inside of the rail. This is either done by the goods cars, the tender, the truck of the engine or the driving-wheels. Now all except the last have a wheel-base of about 4 feet 9 inches, swivel from a point midway between their axles about 2½ half feet distant, and have on each wheel a weight of about 2½ tons. The last have a wheel-base of from 6 to 8 feet, swivel from a point forward from their axles and about 12½ feet distant, and have on each wheel a weight of 5 tons. The mere statement without argument appears to me sufficient. The power of injury (coming from rigidity) caused by the same amount of force is in the one case $2\frac{1}{2} \times 2\frac{1}{2} = 6.25$ tons feet and in the other $5 \times 12\frac{1}{2} = 62.5$ tons feet—just ten times as much.

But Mr. Forney says that "If the rails are very much "worn on account of the lateral rigidity of the engine "wheel-base, then the flange would also be worn to "very nearly the same extent." I have shown before the very different kinds of wearing to which the wrought iron, cast iron and steel are exposed, and merely remark again that when a great sliver (lamina) is broken out of the rail, the more granular material is only abraded superficially.

But again he says, "That the driving-wheel flanges "do not impinge against the rails more than the truck-"wheels is also shown by the relative wear. An ordi-"nary steel tire, which has about double the circum-"ference will run about twice as far as a truck, without "being turned or replaced. Now if the wear of the "former was greater on account of the rigidity of the "wheel-base, it would not do twice the service of the "wheel of half the size, especially with double the "weight resting upon it."

Reaction is equal to action, as Mr. Forney very properly says in regard to this matter, but the effects on two different bodies are not necessarily equal. An egg thrown on a marble floor proves the formula in its breakage. Diamonds cut glass; yet glass cuts not diamond. A ball speeding its way into a soldier's heart proves the law as truly when passing through and into the heart of a comrade as though it had been stopped with great concussion. Yet the bullet which has caused desolation to families may itself be little harmed by the reaction.

Now if the driving-wheel has just twice the circumference of the truck-wheel, it should do with the same weight and same material just twice the service. But it has just twice the weight; then from these two causes it should do just the service. But one is fine steel and the other ordinarily good cast iron, and the difference of wear upon the two should be as steel to cast iron with the truck wheels, and as steel to wrought iron with the track.

In continuation of the same subject is a fact which, strangely enough, Mr. Forney has not touched upon, although his own engine does much to decrease the evil. This is the want of balance, the one-third weight at one end, the two-thirds at the other. It is this which causes, in connection with whatever overhang there may be, a galloping or plunging motion, which greatly increases the damage to track and wheels. There is a constant tendency, in rapid motion, to lift the truck-wheels clear of the track, thus throwing increased load momentarily upon the drivers, and to throw part of the leading-wheel weight upon the trailing-wheels, also momentarily, and like the other, with the effect of impact. By the necessary recoil this is transferred to the leading-wheels and truck-wheels, each time having the effect of impact mitigated, of course, by the springs and equalizers.

I do wish that practical locomotive engineers would take this matter up. It would require very little ingenuity and less labor to find, in a trip or two, the maximum amount which the springs had been compressed; and this, supposing roughly that each quarter of an inch of compression represented an additional ton thrown suddenly upon the drivers, would give us some idea of the force of that "kicking and pawing" which undoubtedly do take place, with great frequency and force. This last difficulty is beyond and apart from the difficulties attempted to be proved before, and may be considered as the insult added to injury which our unruly servant, pampered too much in one direction, puts upon us.

And now to sum up the matter, as it seems to me:

1. The useless weight of the engine is from 5 to 20 per cent. on freight and passenger trains, or a little over a dollar per ton of itself per day, being about $40.50 for an ordinary 30-ton engine per day, and quite enough, if saved by the Fairlie engine, to pay the engine expenses for that day.

2. That the expense of iron rails is quite enough, and may be decreased from 67 lbs. to 34 lbs. or less per yard, or from $10,000 to $5,000 or less per mile, if the Fairlie engine is adopted, and that increasing the weight would not stop the destruction consequent on lamination, which is the result of pressure, altering the cohesive character of the iron; that American engineers have properly decided against 3 and 4-coupled wheels, with a long wheel base, for ordinary use, but have not decided against the use of trucks nor the Fairlie engine. In short, that they have rightly decided according to the expriences of the past, but have not decided against improvement in the future.

3. That the rigidity of the driving-wheel axles in the frame of an engine, with or without a leading truck, is damaging and destructive to a very great extent.

I cannot leave the subject without—as it has been introduced—adding a few words on the Forney engine. It saves the one-third loss of engine, but not the tender weight. It improves the balance of parts very materially. The design is altogether good, and companies about changing existing engines for much repair, or alteration of gauge, would do well to try it. What improved details have been introduced, or what practical advantage or disadvantage may obtain to the convenience of running them, I do not know; but think, as may be gathered from all this paper, that Mr. Forney has taken a step in the right direction, which could only be improved by his taking, as Mr. Fairlie has done, a stride.

Louis Nickerson,
Civil Engineer.

AN AMERICAN ENGINEER IN ENGLAND.

Sheffield, England, April 23, 1871.

To the Editor of the Railroad Gazette:

If any American railroad engineer were to write of all he had seen in England that was at once new and interesting, he would have to begin early and write late, and also run the serious risk of wearying his readers. Besides this, if he were to say exactly what his first impressions were, there would be some danger of his being misunderstood, and of being supposed desirous of making light of that which had been shown to be of well approved value in practice, or which had been adopted many years before and which, as a standard or usual form of construction, could not be departed from except at great expense, and with long continued inconvenience, both to the traveling public and to the railroad authorities.

Thus, if the engines and carriages were thought at first sight to be more toy-like than suited to real service, the explanation should be allowed that they were so only by contrast with the immense roofed-in and walled enclosure of one of the gigantic terminal stations, of which so many are now to be found in England and so few as yet at home.

That English engines and carriages are not toys, however, but are veritable full-grown structures, will be readily conceded when a host of people is seen to appear, correspondingly dwarfed, however, under one of these immense roofs, and on one of these acre-large platforms, and is almost in a moment swallowed up through the numerous side doors of one of these trains of carriages, and finally whirled away in a twinkling at no mean pace, even though the train may be compelled to stop again at a station 500 yards away.

It is plain, too, that the massive brick arches and piers which carry the city and suburban lines, sometimes for miles even above the roofs of good-sized houses and across busy and crowded streets, are not built for any toys to creep over, but, as in London, for a traffic such as no other place or city in the world knows, and that can be safely and quickly conveyed—as quickly it must be from its very amount—only by the most solid and lasting permanent way, by this ponderous and costly machinery, and also under a vigilant and patient management that, after all its toil and painstaking, must consider itself doing well if only four per cent. on the capital be earned per year.

If any further evidence were needed that toys are not run upon English railways, it could be had in the fact of the constant and rapid wear of the rails on the chief thoroughfares, under the trying service required of them. Probably nothing astonished the early builders of railroads more than finding that the rails they laid down, of seemingly durable and indestructible iron, would wear out at all, even under the light traffic of those days, and it is certainly now no reproach to the unsurpassed steel rails laid on all these leading lines that they in turn are wearing under the dragging weight of the millions of passengers and the tens of millions of tons of goods that fly over them month by month.

Hardly any one general thought will be more firmly fixed in a stranger's mind than the solidity and permanence of nearly everything pertaining to these English railroads; but it is important to remember, at the same time, that some of these massive structures have been erected at a cost that could hardly have been borne by any people but the English, and that now is beginning to be borne by some of them with uneasiness and complaint. It is altogether likely, however, that this style of work, so to call it, is one of the peculiarities and preferences of the English mind, since it is manifest in many other ways; and in some of these, it is true, it is to be accounted for, not from taste or choice alone, but from the actual necessities of the case. As an illustration of this general idea, along some lane where, in the United States, we should never find more than a common board fence, or, at most, a neat picket railing, here a solid brick wall will be placed (with perhaps a garnishing on the top of broken glass bottles, merely to keep the cats from crossing it) or now and then, for a short back garden fence, a row of good sized stone slabs will be set up in the ground, or an out-shed for fuel will be seen covered in with this same enduring material. These peculiarities are mentioned, not in the least as merely amusing, but for the purpose of showing that here it is a different people that is dealing with the common circumstances or problems of every-day life, and that the only materials at command may be very different from those common in America. It has been truly remarked that the manners and customs of any people different from ourselves, whatever they may be, and in reference to whatever subject, can never be to a thinking person a subject of trifling, but that the difficulty of circumstance or position of early training shall be our study, that we may discover, if possible, whether we, in like difficulty or position, would have been wiser or more in advance of our day. Let me say, then, that in all these novel things, however unaccountable many of them may be there are many to approve, many things to be admired, and not a few simply to be wondered at; and this can be said too with a clear conscience, not abating a shade of the loyalty a true American owes to the land of his birth, as being the place where, if anywhere, any means is wisely adapted to the end had in view, and where his scanty money is compelled to yield, and does yield, the quickest and largest return.

In this connection it is fair to remark that some American devices, when seen from this side of the water only, do not fully command that approval of the English engineering mind which is accorded to them when seen upon their own American soil, and in connection with the general circumstances of which this or that peculiarity may form a component part. For instance, to mention one thing that here is nearly or quite incomprehensible to me, until I remember from what the practice first sprung, who, either English or American, would think of abandoning the snug, convenient and sightly cab on the American locomotive, and of giving the men only a front weather plate four feet wide, perhaps in rare cases a side and roof plate two feet deep, behind which to shiver all night along the Hudson River, or on an Ohio or Iowa prairie, making express time, and with the murcury at or below zero? Yet stage coaches were driven here for scores of years by men who stoutly faced all storms with only cap and wrapper to protect them, and so when stage coaches were put upon wheels suited to the rails, the men began their steam driving in the good old garb that had never failed them, and that probably never will. How the drivers (they are all known here as engine-drivers or enginemen, and never as engineers) stand the Scotch snows, I can only guess, for I haven't yet been in Scotland, but a better day will surely come for their comfort and convenience, in this respect.

The form given to some of the new carriages (they are invariably known as carriages and not as cars) on leading lines is still copied in some points from the curved outline of the old stage coach, and the same old door-latch and loop-handle for turning it is chiefly used. The loose falling window, generally with a strap to raise or hold it, is still found in all the carriage doors, while a window that can be opened by any means, other than the one in the door, would be very hard to find. I have never ridden in one of the old stage coaches, but believe, nevertheless, that little risk would be run in saying that when the early railroad carriages were put upon wheels the springs that were placed beneath them could hardly have been copied, even in idea, from any before in use on coaches, for the vertical motion of the average railroad carriage upon its springs is very slight, and, to my accustomed mind, quite unpleasant. I am unable to compare this motion, or rather the general sensation of riding here on the railroads, whether first, second, or third-class, on an express, medium or slow train (and I have tried them all), to anything that at all resembles it—in tremulous jarring or vibration, I mean—except the jarring of an ordinary American passenger car with the brakes set hard, running at about half speed, as when approaching a station.

This feeling, or sensation—and very possibly it will not agree with the impression of many who have tried precisely the same thing—is produced, as it seems to me, in great part by the almost total lack of any rubber springs, and by the use of so stiff a steel spring over each axle box, and perhaps to one or two other causes. Another greatly missed feature of what seems to be the easier motion of the American car, is its capability of a side-*swinging* motion on the sway links or bars provided for that very purpose. Here if in passing a guard rail, or a switch, a carriage is a little out of line or out of its true position on the center of the track, it is likely to be set over by a side thrust or knock that comes to the whole body of the carriage at once, saving the very slight end-play there may be in the axles and in the axle-box jaws. It is true that by the spring buffers and screw couplings all the carriages in a passenger train are drawn into a nearly continuous stretched line, so that any side-swaying or pushing of a carriage while in motion is somewhat modified by the tension on the couplings at each end; but how carriages fitted on springs in this way—which, however, has the merit of great simplicity—could be run, if it were required, with any comfort, or even with comparative safety, over a track thrown out of line or level by frost, or upon an ill kept line, it is not easy to see. It is fair to say, however, that derangement of rails by frost is most carefully guarded against here, even by the most painstaking endeavor in draining and ballasting, so that, after all, the generous swing we sometimes get at home, on a new or frost-heaved track, is quite unknown here.

RAIL SUPPLY FROM ENGLAND.

I.

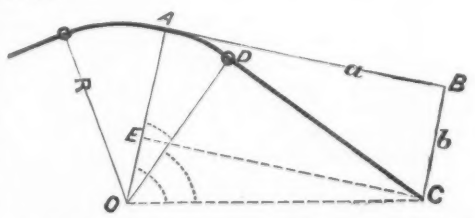
To the Editor of the Railroad Gazette:

It is a well known fact that whenever a demand increases, the supply, as a general rule, follows it step by step, and the price, though it may be temporarily forced up by sudden emergencies, undergoes a gradual reduction as the result, while the quality at the same time deteriorates in proportion. So also with rails. The general outcry about bad rails is only too loud on the part of our railroad authorities to prove at least the latter part of this assertion, and we will therefore try to throw some light on the subject through a series of articles headed as above.

In olden days there were none of the complaints heard of which now are of daily occurrence; whence then do they arise? There are two sides to this question, which may be termed that of the rail-makers and that of the railway authorities, and we will first regard from the one standpoint and then from the other. Some twenty years ago rails were made almost exclusively in Wales and in Staffordshire, the great Cleveland district not having then been as yet discovered. The ores produced in the two first-named districts were of the same good character as at present, and the demand for railway iron was not greater than could be supplied from these ores. As the demand increased, however, the intermixture of more impure ores became unavoidable, and as long as we have not yet learned the art of making a silk purse out of a sow's ear the quality must needs deteriorate accordingly. New districts, also, started rail-making; competition influenced the price of manufacture, and various improvements in the rolling operation were introduced from time to time; but these so-called improvements tended chiefly to the saving of labor and fuel, and to prevent the waste of iron, without any special regard to keeping up the quality of the production: and so we have got on by degrees to the present state of things, reducing the cost of iron rails by nearly one-half of what it was when railroads first started into existence, but, unfortunately, bringing down the quality in a corresponding degree. This is the aspect of the case as seen from the side of the rail-makers; viewed from that of the consumers, or railroad authorities, we think it must be admitted that they have shared the profits of the advancement of rail-making to an equal degree with the manufacturers, by obtaining a cheap rail for such new lines where the traffic could not at first be of much importance, but as it increased would allow of these inferior rails being exchanged for others of a superior and more enduring description. It is said by many, however, that in the present day it is not possible to obtain as good and lasting rails as those which were made twenty years ago. We cannot agree with them in this, but would rather suggest that they do not go the right way to work to obtain them, or else they want equally good rails now as those produced in former times, for something like half the price. There are plenty of good rails to be had nowadays which will resist a much heavier traffic than ever existed in the olden time—such, for instance, as steel rails, steel-headed rails and extra iron rails, all to be obtained at reasonable prices in proportion to their intrinsic value, provided the proper means are adopted to secure the right article. It is the obvious duty of every railroad president, in furnishing his track with rails, to study how to get full value for the money expended, and this we venture to think would be best done by dealing with the makers direct, making a fair use of competition, and in clearly specifying the description that is required, to see that it is manufactured accordingly; instead of, as now is too frequently the case, giving orders through intermediate hands, sometimes as many as half a dozen, so that when they reach the makers there is generally very little left of either specification for extra make, or of the price to be paid for it. Naturally enough, the manufacturer will do his best to please his customers if he knows that the quality of his production, if approved, is likely to lead to extended business transactions, but not so when he is in the dark as to the real employer, or where the rails are going to, in consequence of intermediate agencies. There has been much said but little done in the way of guarantees for the duration of rails in a certain space of time, and such stipulations have, on the whole, proved to be thoroughly unpractical, inasmuch as time has really little or nothing to do with it. Leave a bottle of wine quiet and it will last forever, and the same rule will apply to rails; for inasmuch as no strict data can be offered of the traffic the rails will have to stand, or of the maintenance of road or rolling stock, etc., there will always be a variety of ways open for the rail-makers to elude penalties of that nature, as has been abundantly shown in numerous instances where guarantee has been given. The old rule, "if you do not look after your interest you will have to suffer for it," holds good in respect of rail-supply just as much as of any other transaction. We will, in following articles on this subject, enter more fully on the technical part of rail manufacture, different kinds of specifications, inspection, etc.

Laying Out Railroad Curves.

Mr. H. W. Lewis, C. E., sends from Pleasant Hill, Mo., the following solution of a problem in laying out curves:



From a point, A, on a curve of radius, R, the latitude, a, and departure, b, of a point, C, are given; to continue the curve until the tangent shall pass through C.

The curve must be continued a number of stations equal to $\frac{\text{angle } A\,O\,D}{\text{degree of curve}}$. To find $A\,O\,D$, draw $C\,E$ perpendicular to radius, $O\,A$, or its prolongation, and draw $C\,O$ to the center of the circle.

Then $\frac{R}{\sqrt{a^2+(R\sim b)^2}} = \text{cos. } C\,O\,D$;

and $\frac{R\sim b}{\sqrt{a^2+(R\sim b)^2}} = \text{cos. } C\,O\,A$.

But $C\,O\,A - C\,O\,D = A\,O\,D$, when R exceeds b; and $180^\circ - (C\,O\,A + C\,O\,D) = A\,O\,D$ when b exceeds R.

—A reduction of $2.50 in first-class fares from New York to St. Paul and points on the Upper Mississippi has been announced. The telegraph announced it as a freak in rates by the Erie Company, and reported that a general reduction is probable. But the above reduction is regular and agreed upon.

CRAIG & BREVOORT'S PATENT CONDENSER FOR STEAM PUMPS.

The annexed engravings represent a condenser to be attached to the ordinary steam pump, thereby bringing it within the class of low pressure, or, more properly speaking, of condensing engines, the steam, when it has done its work in the cylinder, instead of being exhausted into the atmosphere, is conducted to the condenser, on its entry into which it meets the water drawn by the pump, and is immediately condensed. The description is chiefly in the words of the proprietors. The cut No. 1 represents a vertical section of the condenser, and No. 2 an elevation.

The flange *D* is bolted to the suction orifice of the pump, and the flange *S* to the pipe leading to the well, or whatever source of supply the pump may have; *W* is a water-jacket surrounding the main chamber of the condenser, *B*, and with which the suction-pipe, *S*, communicates, permitting a free circulation of water within the jacket and into the hollow cover or top through which the series of openings, one of which is shown at *A*, and from thence into the body of condenser, *B*, through pipe, *P*, carried by float, *F;* the pipe, *P*, also acts automatically as a valve to enlarge or contract the space through which the water enters it, by which means the possibility of the condenser being at any time flooded is avoided. The pipe *P*, it will be observed, also acts as a guide to float *F*.

The valve, *C* (shown in cut No. 1), which is raised or lowered by means of a screwed stem—shown coming through the elbow in cut No. 2—is for the purpose of increasing or decreasing the flow of water, according to the capacity of the pump to which it is attached.

The exhaust-pipe from the steam cylinder is screwed into the cover at *E;* the exhaust steam is thus thrown directly into contact with the water entering the condenser on its way to water-cylinder of pump, through *D*. The vacuum which is of course immediately formed, acts on the exhaust side of the steam piston, aiding in its work in proportion to the amount of vacuum obtained.

When we consider that steam pumps are usually constructed with steam cylinders from *three* to *four* times larger in area than the water cylinders, and that we have a vacuum equal to about 13 pounds pressure, which vacuum has the large piston of the steam cylinder to act upon, we see that the pump is exactly in the position of any condensing engine. Suppose we take a pump of the following dimensions: 6 inches diameter of steam cylinder, 3 inches diameter of water cylinder, pumping against, say, 80 pounds. The steam piston will have a pressure of, say, 28 pounds above the atmosphere on it. Five pounds of this is used up in overcoming the friction of the pump, and the other 20 pounds is left to perform the work. The condition of the pump, if a condenser were attached, would be as follows: 13 pounds of the steam pressure would have its place taken by the vacuum; consequently 12 pounds of steam would be sufficient for the working of the pump. This is a direct saving of 52 per cent. when pumping at 80 pounds pressure in the water cylinder. When the pressure against which the pump is working is less, the percentage of gain will be greater. The economy is plainly shown by figures; also by indicator cards taken from the pump, from which cards the above calculations were made.

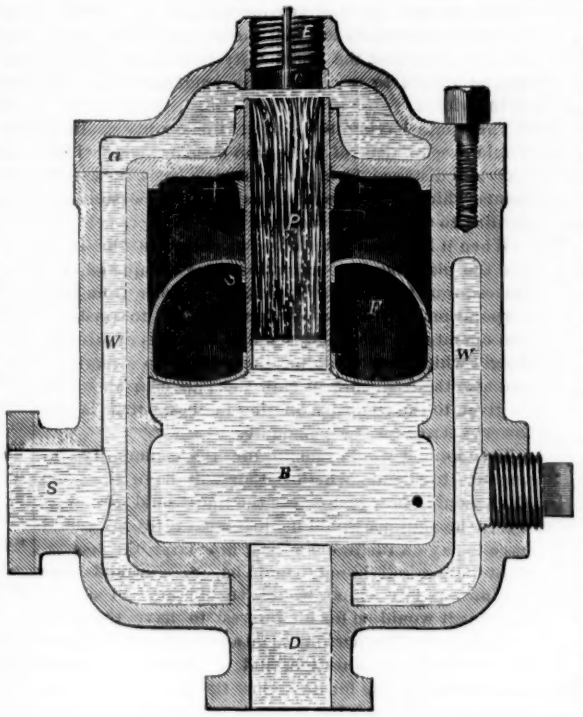
It is, however, not only in obtaining a vacuum that the advantage of this condenser in its application to steam pumps consists. When the pump is used for feeding a steam boiler, or for any purpose requiring hot or warm water, all the heat of the exhaust steam, except that which is unavoidably lost by radiation, is utilized, and consequently the economy effected thereby is very great.

The extreme simplicity in the construction of this condenser is such that it can be managed and taken care of even by those who are not thoroughly conversant with all the details of the condensing steam engine

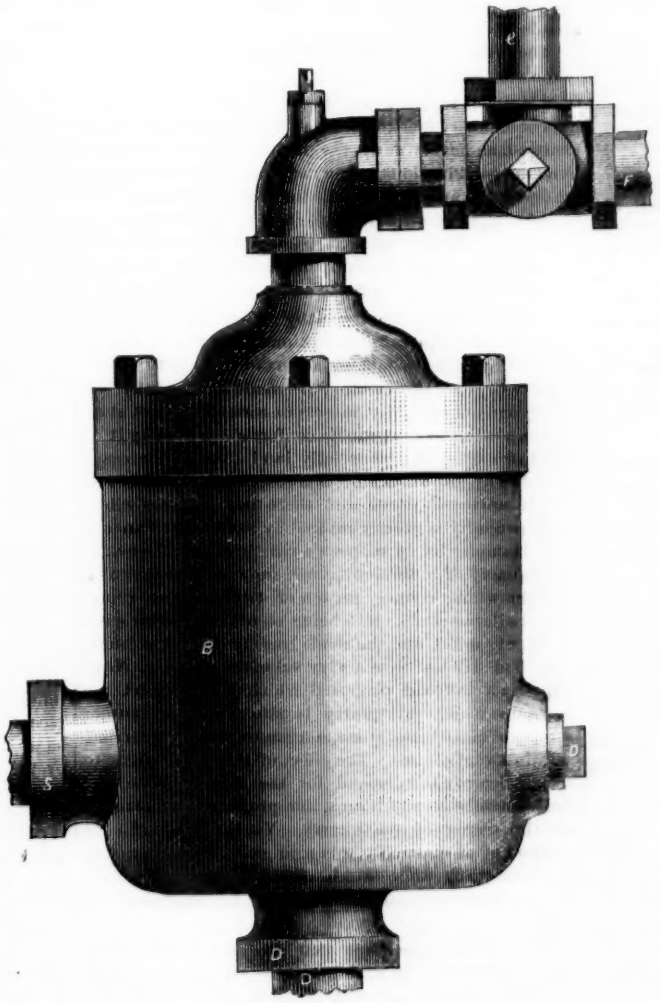
If at any time it is desirable to run the pump without the condenser, it is only necessary to turn the three-way cock, which is placed in the exhaust pipe, into such a position as to cause the steam cylinder to exhaust into the atmosphere; when this is done the pump is perfectly free from the condenser and acts as if it were not attached.

This condenser is specially useful for pumps running in mines, or any other position where trouble is experienced in getting rid of the exhaust steam.

For all further information apply to Henry L. Brevoort, No. 128 Broadway, Room 13, New York.



No. 1.



No. 2.

MECHANICS AND ENGINEERING.

Station Indicator.

Mr. D. D. Angell, Master of Transportation of the Pittsburgh & Connellsville Railroad, has invented a station indicator, which the *Iron World and Manufacturer* describes as consisting of "a dial-plate with dial hands similar to those of a clock. On this dial will be the name of each station, and underneath it will be a bell. Connected with this, on the platform, will be a lever, the moving of which will ring the bell inside the car, thereby attracting the attention of passengers, who may, on looking at the hand on the dial, know exactly where the train is. The hand will move every time the bell is rung. The invention is quite an important one, and we have no doubt will be found quite practicable."

Wilmington Car Works.

It has been decided to locate a branch of these works at Urbana, Ill. The site of the shops there has been located, and the building is to commence at once.

The East River Bridge.

The second great caisson of the East River Bridge was launched last Monday. The New York *Evening Post* thus describes the preparations for the launching:

"The caisson was erected on a foundation of fourteen rows of 'blocking,' or short timbers laid one upon another in the fashion of a cob-house. To prepare it for launching every other row of blocking was removed, and replaced by a sliding way.

"The slides were composed of long timbers, the upper surface of which was coated by a composition of tallow and castile soap. In order to prevent this sticky substance from gluing the timbers and the bottom of the caisson together, the timbers were also covered by a coating of oil, and numerous small holes were drilled in them, into which oil was poured

"The timbers composing the sides were eleven by twenty-two inches in diameter. Wedges were tightly driven between the upper surface and the bottom of the caisson.

"The caisson was built on an incline of seven feet in the one hundred and two feet of its length. Hence, when the wedges and the rows of blocking were knocked from under, and its weight rested on the slippery surface of the sliding ways, it glided down them into the river.

"In order that the caisson might float securely, it was provided with a false bottom, which will have to be removed before sinking it."

When all was ready for the launching, and seven tugs were clustered in the slip ready to attach ropes and drag the caisson into the water, the monster suddenly anticipated the ceremonies by proceeding to launch itself. Sliding rapidly down the ways and piling up a billow of water before it, it struck a tug directly in its path and projected it forward at a great rate, doing no great damage, but involving a number of small boats in serious difficulty.

After the launch the caisson was made fast to the piers, as the ebb-tide rendered it necessary to postpone towing it into position until the next day. The caisson draws 13 feet of water—about the same as the first one, launched on the Brooklyn side.

The Buffalo Bridge.

The caisson for pier No. 4 of the International Bridge was last week towed to its place in the Niagara River. The caisson for pier No. 5 is in process of construction, and two more, or seven in all, are to be built. The iron for the superstructure is arriving, and it is hoped to have the bridge completed this year.

Union Depot in St. Louis.

A great Union passenger depot is proposed in St. Louis. It ought to have been proposed and constructed long ago, for now the requisite ground in a convenient location would cost enough to build a considerable railroad, and if a distant location is made, it will be no more convenient (after the bridge is completed) and actually no nearer than are the stations in East St. Louis now. It has been proposed to take for this purpose three blocks adjoining the south side of Clark avenue, extending from Eighth to Eleventh street, but to reach this from the bridge some of the best property in the city must be crossed. This location is just about as far from the St. Louis Court House as the Van Buren Street Depot is from the Chicago Court House—about three-eights of a mile.

Wooden Railroads.

Mr. G. W. Pearsons writes from Ogdensburg, N. Y., to the *Scientific American*, as follows:

"On the Clifton Railroad, I understand they are principally maple. This wood is not so durable as oak in resisting decay, but wears far better under a wheel. The reputation which the Clifton road bears here among those best acquainted with it, and uninterested in it, seems to be quite similar to that of Messrs. Speer with theirs, so far as its permanent value is considered."

The Messrs. Speer found their road wearing out very fast until they put iron on their wooden rails, thus virtually making a "strap-rail" road of it. So we travel over the old ground.

St. Joseph Bridge.

The company ask for proposals for building their bridge over the Missouri River, which is to be a draw-bridge, a wagon, railroad and foot bridge. The substructure is to be of stone piers, founded on rock, except the east abutment, which is to have a pile foundation. The superstructure is to be of iron. The work must be completed before the first of November, 1872. The plans and specifications can be seen after Monday next, and proposals will be received up to the first of June.

—B. F. Patrick, long General Passenger Agent of the Chicago & Northwestery Railway and widely known among railroad men, has been appointed General Passenger Agent of the Union Seamboat Company and the Atlantic, Duluth & Pacific (Lake Superior) lines.

RAILROAD GAZETTE

PUBLISHED EVERY SATURDAY.

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Editorial Announcements.

Correspondence.—We cordially invite the co-operation of the Railroad Public in affording us the material for a thorough and worthy Railroad paper. Railroad news, annual reports, notices of appointments, resignations, etc., and information concerning improvements will be gratefully received. We make it our business to inform the public concerning the progress of new lines, and are always glad to receive news of them.

Inventions.—Those who wish to make their inventions known to railroad men can have them fully described in the RAILROAD GAZETTE, *if not previously published,* FREE OF CHARGE. *They are invited to send us drawings or models and specifications. When engravings are necessary the inventor is expected to furnish his own engravings or to pay for them.*

Engineering and Mechanics.—Communications and correspondence relating to these subjects should be directed to M. N. Forney, No. 72 Broadway, New York. Subscriptions and advertisements will be received at the New York office, and any other business transacted with those to whom that office is most convenient.

Articles.—We desire articles relating to railroads, and, if acceptable, will pay liberally for them. Articles concerning railroad management, engineering, rolling stock and machinery, by men practically acquainted with these subjects, are especially desired.

MUNICIPAL AID TO RAILROADS.

Mr. Charles Reemelin, a citizen of Cincinnati who has studied more than most men the relation of routes of transportation to the community, has sent to the Ohio Railroad Commissioner a paper relating to the establishment of railroad routes and the providing of aid for their construction by the community, as represented in counties and towns, which paper is published in the appendix to the Commissioner's report for 1870. Mr. Reemelin's paper is in part a translation and in part founded upon a paper published in the *Social Science Quarterly*, of Berlin, for July, 1870.

The propriety of a governmental direction in determining the routes of railroads is urged, not simply because they should be made to serve the whole community, but because private individuals and corporations may find their profit in what will injure the community. For the same reason it is argued that towns or counties alone should not be permitted to determine routes, but that the State should be joined with them, in order that every line, long or short, may be made part of a system, fitted to serve the whole community fairly, and not to unduly favor one town or section at the expense of another—that is, that small communities, in their selfishness, may not be permitted to work against each other, but that every new route may be made to minister as much as possible to the general good.

But the question most mooted at present is the propriety and most feasible plan of giving public aid to such improvements. There is a wide-spread belief, which the courts of some States have made a law, that an ordinary tax on all property, whether benefited or not by the improvement, is unjust. On the other hand, the method of assessing the cost of the improvements on the adjacent property, while it may exempt from payment all or nearly all that property which is not directly benefited, also exempts much which, in a greater or less degree, is made more valuable by the improvement. That method will be best which requires those to pay for the work who have the use of it, either directly or indirectly. The *Social Science Quarterly* proposes that the cost of turnpike roads be assessed, first, on the land which they serve; second, on the buildings, and third, on the owners of draught animals and vehicles.

To adapt this principle to railroads, Mr. Reemelin would have the route of every new railroad determined by the State Commissioner of Railroads and engineers acting under his directions, on the application of ten or more persons, or of the authorities of a county or city, who shall give security for the expenses of the survey in case no road is constructed. The Commissioner is expected to see that the road is well placed—so as to serve best the community as a whole, without special regard to any particular neighborhood, town, or individual.

The route having been fixed, the county auditors would prepare lists of those who own property within a certain distance from the line, as a basis for assessments, which should be made, as nearly as possible, according to the benefits received.

When it has been determined to construct the road, and the plans and specifications are completed, the Governor of the State will invite proposals from any corporation, existing or to be incorporated, to construct and operate the road, they naming the rates of fare and freight which they will bind themselves to carry for, and also the frequency of trains. The charter would be given to the company offering the best—that is the lowest—terms for the community.

This done, it would remain for the community interested to decide whether they will have the road Each would know just where the line would run, just where the stations would be, just what rates he would have to pay on the line, and just how large the assessment on him individually would be, and so would have the information which would enable him to decide whether it would be for his interest to have the road constructed. The persons to be assessed, *and no others*, would vote on the question, and a majority of their votes would decide for or against the plan. If the decision is favorable, a bill for each assessment in thirty-six monthly instalments would be given to the corporation leasing the road, which would have authority to collect these bills as assessments are collected in cities.

Mr. Reemelin believes that the general interests of the community would be so promoted by such railroads that it might be proper for the State to give, perhaps, $1,000 per mile, and the county $500 per mile, in aid of roads within their limits.

The merits of this plan Mr. Reemelin estimates in the following language:

"It seems to the writer hereof that, under this programme, every meritorious public improvement can be carried, and every unworthy project defeated. It checks vicious combinations at the beginning, and throughout the process, and finally lands the road into the hands of parties most competent to manage it successfully. It steers clear of that perilous tendency in our affairs—a constantly augmenting body of public officers, and an increased patronage in State and county rulers."

This plan is at least worthy of consideration. In many of the States subscriptions to new railroads, to be paid by assessments on all taxable property in the county or town subscribing, are made almost daily. It is beyond question that these assessments are not at all in proportion to the benefits conferred. Usually it is fixed property, and especially land, that is increased in value by improvements in transportation. But this is not universally true, and there may be cases where such property is greatly injured by such improvements. For example, let us suppose a case in which the owner of a quarry of indifferent stone, supplies a large town and the whole country for ten or twelve miles round with building stone, there being no other quarries within twenty miles, and the roads leading to these being very bad. He has thus a very valuable property. Now, suppose a railroad proposed which will connect the town in which this quarry is situated with another quarry of much better stone, much more cheaply quarried, within twenty miles. The effect of this road will be to nearly destroy the demand for the inferior stone, and consequently greatly injure the property and business of the owner of the quarry. Yet by the ordinary method of assessments, this man may be made to pay more than any other citizen of the town for the railroad which will make him poorer by thousands of dollars.

It is not often, perhaps, that property is injured by the construction of a railroad near it; but in every case the benefits are not at all in proportion to the value of the property This is plain enough in the case of a capitalist whose whole fortune is in bonds or other interest-bearing securities. His paper, of course, is not worth a dime more where there is a score of railroads than where there is none. The effect of a special tax on such men is to drive them and their capital away. But to decide just the proportion in which benefits are conferred by improved transportation would be a most delicate and complex task. The wool-grower can draw to market the entire crop of a moderate farm in one or two loads, and it requires little time and costs little to haul it thirty or forty miles even. The grain-grower, on the other hand, has perhaps fifty or a hundred times as many loads to haul to market, and he can afford to pay well to have a station nearer to him. So with merchants and manufacturers of different kinds: some are greatly benefited, some scarcely at all, by the construction of a new railroad. To make them all pay alike without reference to the benefits received is hardly just, and doubtless the conviction of the injustice of such assessments has much to do with the opposition all municipal subscriptions, which has resulted in their prohibition in Ohio, Michigan and Illinois, after extended experience with them.

THEORY AND PRACTICE.

These two words, and the ideas which they represent seem naturally to belong together. To a certain extent they have a sort of reciprocal relation to each other, and, in fact, all knowledge possesses some elements of a theoretical as well as a practical character. In the sense, however, in which they are used in their reference to engineering and mechanical matters, a sort of broad, though not very accurately exact, distinction is made between knowledge which is the result of any deductive process and that acquired from common experience. Of the one most people, as the world goes, are exceedingly suspicious and apprehensive, while the other they feel has an element of certainty about it which can be relied on and implies no risk. A great many people lay very close to their hearts the old saw, that "what has been done can be done again," while of those transactions which exist only in idea, they maintain a most jealous suspicion. Such people want a precedent for all they do. There is about this attitude of mind, or rather of conduct, a certain measure of wisdom, yet it must be remembered that it has its limitations. Of course, so long as there is nothing to be gained by departing from the limits of precedent and venturing into the field of experiment, to do so would only be assuming a risk, without the prospect of any gain. But it must be remembered, that we very soon reach the limit within which precedents can be the rule for the conduct of human affairs. Just so soon as it is necessary to leave the beaten track of experience, then truth can only be discovered by some process of deductive reasoning. It is of such knowlege that practical men are prone to be suspicious. Now if all reasoning were logical, and all data or premises rightly and fully apprehended, then theories would be just as unerring as practical experience, and perhaps more so. The difficulty is, however, that data are so often incorrect or insufficient, premises are misapprehended, or, what is perhaps equally common, the reasoning therefrom is illogical. The practical man, who is probably more accustomed to handling a two-foot rule than to the use of the rules of reasoning, and who can estimate the weight of a locomotive easier and more accurately than that of a mass of testimony or statistics, is unacquainted with the application of close analysis to an argument, and while he could detect a weak point in a bridge, or a flaw in an engine-axle, he is not so sure that he will find the defects and fallacies in a train of reasoning, and therefore he suspects that all such structures are only ingenious devices to throw him from the track of everyday experience.

To a speculative mind it is astonishing how little influence sound reasoning has upon the "general run" of mankind. A position fortified by every conceivable strength of testimony, and by processes of deduction from which there is no escape, will often have no more influence in softening the minds of many people for the reception of the truth than rain has in saturating cabbage leaves. We are all, probably, very much less unprejudiced than we think we are, and less amenable to right reason, and thus it comes that truth existing in idea only so often receives but little credence.

In what we have said of the distrust with which theoretical knowledge is received by men of experience, we do not desire to attribute the fault to the latter alone. It is to a very great degree because the theoretical men present so much which they call knowledge which is only guess-work, more or less shrewd, but often wrong. There is nothing in the nature of at heory which makes it unworthy of credence. It may be true, or it may be untrue, and its errors are just as open to detection as any kind of testimony is. The great source of danger in theoretical knowledge is, that some important elements in the premises or data may be overlooked. The human mind is so exceedingly narrow and limited in its apprehension and operation that few subjects are seen in all their relations until they are tested by practical experience. This is just as true of mechanical science as it is of politics, medicine or social affairs.

Theoretical knowledge has, however, the advantage over that which is derived from practical experience, in that while the latter must always be limited by precedent, the other is boundless as the laws of nature. The one must be confined to the narrow path which already has been traveled, the other can be gathered from any field of discovery. Practical knowledge possesses the advantage of much greater certainty than that which is theoretical, whereas theory has a much greater range and more opportunity of making discovery than mere plodding practicality. Theorists are constantly making mistakes, it is true; but it is also a fact that discoveries are nearly all made by them. It, of course, becomes all men, and engineers especially, to determine very clearly, in undertaking any new project, whether they can afford to risk failure for the chance of making a great discovery. It would be very unwise for a mechanic, whose family is dependent upon the fruits of his work for daily bread, to spend his time in making plans, or devising new inventions, with merely a vague prospect of thus making a discovery which will enrich both him and them. What they all need, and must have each day, is something to eat, and it is folly for him to risk poverty and starvation for all of them for only a very uncertain prospect of success and affluence. We can all postpone being wealthy, even to the end of our lives; but dinner time has a certain inexorable character about it, and can be deferred, at most, only a day or two. Able generals always hesitate about risking the destruction of their armies, even with the prospect of a brilliant victory.

There is, however, a certain sort of luminous power which theoretical knowledge gives to practical experience, which widens its scope and extends its application. The engineer or mechanic with theoretical knowledge will see a meaning in the phenomena that he observes to which a person without such knowledge would be blind. It is this capacity that the exclusively practical men are most apt to resent, and with the greatest injustice. No practical man was ever known to object to a degree of theoretical knowledge no greater than he possessed himself. What they sneer at is a measure of attainment greater than their own. A man unskillful at figures will assert that no one can make any complicated calculations without "beating himself," and he who knows nothing about algebra can hardly regard x's or y's without profanity. Engineers whose mathematical education was limited to algebra and geometry are apt to feel that calculus and the higher mathematics are inventions of a "bloated aristocracy," and, at best are "nonsense." Of course there is such a thing as an affectation of knowledge, but it is just as common among "practical" men as among theorists. In the one case it shows itself by a sort of reticence or indisposition to communicate experience, in the other it hides its light under the guise of learned-looking signs and formulæ.

In fact, the relations of theory and practice are like that of man and wife—so long as they are mutually helpful the good in each is doubled, and the evil lessened; but let animosity instead of affection prevail, and their eyes become blind and wisdom forsakes them. It is much to be desired that theory and practice should always be joined in nuptial relations, and that what has thus been joined no engineer or mechanic should ever put asunder.

The Duties of Railroad Conductors as Conservators of the Peace.

New York is at present disturbed by the conduct of its Philistine population on the cars of the street railroads. The immediate cause of this disquiet was the murder of a passenger on the Broadway line under peculiarly aggravated circumstances. The unfortunate victim was struck down by a somewhat notorious rough for no other cause than that of remonstrating with the murderer for his conduct, which was grossly improper and offensive, to a young lady who was traveling under the care and escort of the murdered man. Since this lamentable occurrence every paper in the city has been bubbling with wrath, both editorial and contributed. Angry correspondents are daily reciting cases of every kind of insult and indignity of which they have been the victims, until one is half disposed to believe that there is not enough manhood left in the whole city to knock down a ruffian, however gross his insults may be or offensive his conduct.

There undoubtedly are some evils which are very apt to attend a state of society in which every man takes it upon himself to resent insults, but certainly it can hardly be so bad as the condition of things in which no lady or young girl can be sure that she will be treated respectfully in a public conveyance by day or at night. The doctrine of non-resistance excepting for self defense is certainly carried too far when the barriers which protect female purity can be broken down with impunity. There are some things which all men should defend more jealously than life, and it is cowardly and stupid to call on the law or its officers to do what any courageous man should do for himself. There are some rights which the law is too slow and cumbrous to protect. That of defending a lady under one's care from insult is one of them.

That the railroad companies or their employes have been blameless in the matter, it would be folly to say; but the extent of their responsibility for the conduct of the passengers on their cars is a question to which there is two sides. From the tone of the papers we might infer that whenever a conductor saw persons on his cars whom he suspected of being thieves or pickpockets, that he should stop and put them off. A duty the performance of which, in the absence of authority to make arrests, would doubtless be pleasanter to the spectators than to the conductor.

That a certain degree of responsibility attaches to railroad companies and their agents for the conduct of passengers there can of course be no doubt, but the precise manner in which they should undertake to preserve the peace is quite another matter. The fault which the public finds is, that they so seldom exercise any of the prerogatives of their position to defend the civil from the uncivil, or the decent from the indecent. Not many months ago it was the writer's lot to travel eastward on one of the leading roads of the country. Having traveled much and being weary and needing rest, he took a sleeping car and paid the usual sum for a berth. About twelve o'clock at night, and when he had just fallen asleep, a band of some half dozen roistering men, who were bent on having what is misnamed a "good time," entered the car. A bottle of whisky and cards were soon produced, and sleep thereafter was impossible. The conductor was appealed to, and he remonstrated mildly; but it had no effect in suppressing their shouts or making their very stupid and indecent stories less disgusting. Under the circumstances, in the absence of any authority to make arrests, it seems obviously the duty of the conductor to use the means at his disposal, and telegraph to the station ahead for an officer of the law to be in readiness and arrest the whole party of broilers who could then be prosecuted by the company for disturbing the peace or any other crimes of which they may have been guilty. A very few such examples, made public, would very soon cause the authority of conductors to be observed and heeded.

On street cars very much the same course could be pursued, excepting that it would be much easier for the ruffians to escape than from the cars of a steam road. In the latter they can be locked in, if necessary, and even though they are not, jumping from a train when at full speed, in this case at least, has the merit that it would endanger the necks of those who might, under the circumstances, be tempted thus to evade the law.

If street-car conductors were supplied with some sort of alarm whistle or rattle, by which a policeman could be called at any time to arrest any passengers who were disposed to be disorderly, it would give those in charge of the cars the means of having disturbers promptly arrested, and the companies could then have them punished in a legal manner, as they would thus have the evidence in the case under their control.

In New York, however, there is reason for suspecting that the railroad companies are courting political influence by employing "men inside politics," or selecting employes from our governing classes, or, in other words, our criminal population. Of course such an evil as that is much deeper down, and a great deal more disheartening, than any questions of railroad management.

The Lake Shore Report.

Last year the Lake Shore & Michigan Southern Railway Company, at its annual meeting, reported only the earnings and expenses of the road, it being difficult to give a uniform detailed statement of the operations of a line that, during the year, had been managed first by four, then by three, and later by two companies, and finally by one. A statement in some detail for the year ending June 30, 1870, was made to the Ohio Commissioner of Railroads, but since that time until now we believe that no statement of its earnings has been made public.

The abstract of the report we publish makes no reference to the earnings of the previous year. We make the following comparative statement, premising that the earnings of the Kalamazoo Division (96 miles long) in 1869 were for the period of only three months, and that on that account the average mileage of the road in 1870 was 24 miles or about 2½ per cent. greater:

	1869.	1870.
Gross earnings	$12,945,598 40	$13,457,540 86
Operating expenses	7,911,527 65	8,368,821 08
Net earnings	$5,034,070 71	$5,088,719 78

This shows an increase of $511,942.46, or very nearly 4 per cent., in receipts; an increase of $457,293.43, or about 5¾ per cent., in operating expenses, and an increase of $54,649.07, or about 1.08 per cent., in net earnings. That is, there was but little difference in the business of the two years. The receipts of 1870 must have suffered severely from the unusually low rates prevailing, but as the earnings were sufficient to pay two 4-per-cent. dividends, leaving a surplus sufficient for 1⅛ per cent. more, the stockholders have little reason to complain.

The statement that the earnings for the first four months of 1871 are $393,000 greater than for the corresponding period of 1870, however, makes it probable that the current year will show a large increase, perhaps more than a million.

Altogether the road is one of the handsomest railroad properties in the country; it has an unusually large number of large towns on its lines, and numerous feeders which cannot advantageously give their traffic to any other line. Its business must grow with the growth of the West, of which it is a principal outlet, and even with a considerable reduction of rates in the future, it will continue to be able to pay large dividends on its stock.

The Lease of the New Jersey Railroads.

The reports this week concerning the lease of the roads of the United Companies of New Jersey to the Pennsylvania Railroad Company are substantially as follows:

The committees of the two corporations are said to have finally agreed upon the provisions of the lease at a meeting in Philadelphia last Saturday. These were submitted to the Board of Directors of the United Companies on Monday, who, it is said, recommended only some verbal alterations. But before they adjourned their meeting another company, supposed to be the Philadelphia & Reading, is reported to have offered substantially the same rental as that offered by the Pennsylvania Company and, in addition, a bonus of nearly a million of dollars. One report, dated Tuesday, says that this latter report is discredited in Philadelphia, and that Mr. Gowen, the President of the Reading Company, had said that his company wanted only the canal, but would lease the whole, if necessary, in order to get that, but did not desire to lease unless the Pennsylvania Company should decline.

A report of the same date that the stockholders of the Camden & Amboy Railroad and the Delaware & Raritan Canal met that day and re-elected the old Board of Directors, seven out of nine of which, it was understood, were in favor of letting to the Pennsylvania.

After approval by the directors, such a lease must be submitted to the stockholders, who might not hesitate to disapprove it if better terms were offered, even if as directors some of them had voted in its favor.

The St. Paul & Pacific.

It is now reported that this road will not be extended to Breckenridge on the Red River of the North, as was intended before the sale to the Northern Pacific, but that the southern line will be extended westward rather than northwestward to a point near the foot of Big Stone Lake, while the Mississippi River line is to be extended up the river from Sauk Rapids to a connection with the Northern Pacific at Brainerd, a distance of about 50 miles, and another branch is to be constructed from a point on the main line near Willmar or Kandiyohi north by west to a connection with the Northern Pacific at Otter Tail Lake. With these lines, the St. Paul & Pacific will command all that part of Minnesota north of the latitude of St. Paul, and the Northern Pacific will have its terminus at that city fully as much as at Duluth. Indeed, if the Northern Pacific expects to carry the traffic of the St. Paul & Pacific to Duluth, it should make these cross lines from the northeast to the southwest instead of from the northwest to the southeast as they are now planned. It will, however, with such a system of lines, be able to carry traffic either to St. Paul or Duluth, just as it may be desirable, and the distance from Otter Tail Lake and all points west will be just about the same to Duluth and St. Paul.

"Rail Supply from England."

We give in this number of the RAILROAD GAZETTE the first of a series of articles on this subject by an eminent engineer in England. It is hoped that these articles may serve to direct those who have occasion to purchase rails to the methods by which they may secure

good rails. The complaint is almost universal that the rails now in market usually bear but a fraction of the wear which was borne by those bought fifteen or twenty years ago. Some of the reasons for this decline in quality and some of the measures likely to guard against it may be looked for in these articles.

NEW PUBLICATIONS.

The Ohio Railroad Commissioner's Report.—The report of Mr. George B. Wright, Commissioner of Railroads and Telegraphs for the State of Ohio, for the year 1870, appears in two volumes. The first, which we noticed some time ago, contains a compilation of all the laws and charters affecting the railroads of Ohio. The second, which was published some weeks later, contains the reports required by law of the Ohio railroads, tabular statements compiled therefrom, an account of railroads in progress in the State, a list of new companies incorporated during the year, a list of subscriptions to railroads in the State by counties, towns and cities previous to the adoption of the present constitution (which prohibits such subscriptions), and reports of telegraph companies. These are prefaced by the Commissioner's report, and followed by an appendix containing communications from citizens relating to various subjects connected with railroads and their management.

The whole forms a volume of 372 pages, valuable for its statistics and otherwise.

The Commissioner reports, first, on "complaints and violations of laws," which latter he finds numerous, often open and gross. The laws are in so crude a state that it is impossible to enforce many of them; but it seems very remarkable that apparently no attempt has ever been made to enforce some of the most important. This is especially the case with rates of fare and freight, which were limited by general laws once or twice, and furthermore have been limited in many cases by charter. The Commissioner says of some of these laws: "A strict enforcement of these provisions would compel some companies to ultimately suspend business, prohibit the transportation of certain articles by rail, or compel their transportation below actual cost."

The report says that the law requiring the fencing of railroads is frequently violated, and makes the remarkable statement that "at this time *not one mile in ten* of the railroads of "Ohio is thoroughly fenced."

The law forbidding any director of a railroad company to buy any shares, bonds, or other securities of his company at less than their par value, and that making it unlawful to elect as officer of a railroad any person interested pecuniarily in any express, dispatch, fast freight or transportation company, are supposed to be commonly violated.

Complaint is made that companies do not report promptly and in form required by law.

Accounts are given of the increase, or "watering," of capital stock in the Cleveland, Painesville & Ashtabula, the Cleveland & Toledo, and the Cleveland, Columbus & Cincinnati railroad companies, though no account is given of the occasion, real or pretended, of the several new issues. The Cleveland, Painesville & Ashtabula, according to this showing, increased its capital from $1,500,000 in 1848, the amount authorized by charter, to $8,750,000 in 1869, when it was consolidated with the Cleveland & Toledo Railroad Company. The Cleveland & Toledo increased from $3,000,000 in 1850 to $6,250,000 in 1867, with which amount it was consolidated in 1869 with the Cleveland & Painesville & Ashtabula, forming the Lake Shore Railway, with a capital of $15,000,000. This latter was consolidated with the Michigan Southern & Northern Indiana later in 1869, the latter's stock being $12,125,600. An increase of $300,000 was made between the time of this consolidation and the new consolidation with the Buffalo & Erie, which was taken with a capital stock of $6,000,000. At the last consolidation it was agreed that the capital stock, then amounting to $33,425,000, might be made $50,000,000, but that no division which would make it more than $35,000,000 should be made until authorized by a two-thirds vote at a meeting of stockholders called for that purpose. The stock reported in June 30, 1870, was actually $34,938,000.

There are no lengthy discussions in this report. The information is collected and arranged in such form that with comparatively little labor each person can find the facts in every case and make his own deductions. We shall have occasion to copy some of the matter contained in this volume, when its value will become apparent.

The Transcontinental Excursion of Railroad Agents.—Last September the general ticket, passenger and freight agents of the United States, with their wives, made an excursion to the Pacific, at the invitation and as the guests of the Union and the Central Pacific companies. This proved an exceedingly enjoyable journey, both socially and otherwise, and those who had the good fortune to be of the party were naturally desirous of such a record of it as would keep it ever fresh in their memories. So they have had written by one of the party an entertaining account of the journey, and published it in most exquisite style. It forms a volume of ninety-two large octavo pages, on cream laid paper, with wide margins, and handsomely bound in flexible cloth. It is such a *souvenir* of the journey as every participant can have with him everywhere, and will serve to recall the scenes and incidents as nothing else—save, perhaps, an elaborate private journal—could, and is in itself as elegant as the car in which the party was carried, and an ornament to any parlor. It may, perhaps, be an example to other parties, who, having together an unusually enjoyable episode in their lives, would like an aid to keep it ever vivid in their memories.

Watson's Railroad and County Map of the United States.—The great merit of this map is its cheapness. It gives, on a sheet 4 feet 8 inches long by 3 feet 3 inches wide, the United States nearly as far west as the western boundary of Kansas, with the greater part of Canada. It is intended particularly as a railroad map, and gives the name of each station, with figures showing the distance between every two adjacent stations. So far as errors of omission are concerned, we find but very few of them; nearly every completed road is shown. The part of the Davenport & St. Paul road between Davenport and De Witt is marked as incomplete, and the Milwaukee & St. Paul's Eagle & Elkhorn Branch is not given. Likewise the Chicago & Southwestern is marked as incomplete beyond Fairfield. The errors of commission are much more frequent, as is common with maps, whose makers are too ambitious to include all the lines that are to be made, in addition to those in operation. So, on this map, in Iowa alone, we find the St. Paul & Sioux City road, not a foot of which is graded even in Iowa, shown as completed; a road (not yet begun, we believe,) appears as in running order between Fort Dodge and Algona; there is 30 or 40 miles too much of the Iowa & Dakota Division of the Milwaukee & St. Paul; a short road which is now not even thought of, we believe, is put down between Iowa Falls and Hampton; a road for which men are now trying to raise subscriptions, is shown between Ackley and Clarksville; a non-existent road is marked as built between Muscatine and Anamosa; the Burlington, Cedar Rapids & Minnesota road extends about eighty miles too far, the part just begun between Cedar Falls and Forest City, passing through Mason City, being shown as completed; the section of the Central of Iowa between Albia and Moulton is also shown as completed; a line is shown as extending southward from Osceola, on the Burlington & Missouri River road, southward to the Missouri line.

This is a serious fault, as it is apt to mislead those who are looking up routes.

On the back of this map is printed one of the United States, from Lake Michigan to the Pacific, thus showing the part omitted on the larger map, and also a map of the Western Hemisphere. The large map is colored by counties; the other in States.

This map is sold largely by agents, who obtain supplies for the Northwest of D. Needham, at No. 66 Lake street, Chicago. The publisher is Gaylord Watson, New York.

Hunt's Merchants' Magazine Year Book.—The publishers of the *Commercial and Financial Chronicle* of New York (with which *Hunt's Merchants' Magazine* has been consolidated), which we have found the best informed and most trustworthy as to news, and by all odds the ablest in discussions, of American financial journals, have recently issued a "Year Book" under the above title, which contains a great variety of statistics on various subjects, just such as a business man is likely to have frequent occasion to use, but without this book might have to hunt long for in old files of newspaper, or in scrap-books. We can give the best idea of the work and its value by a partial list of its contents. The first chapter is a financial review for 1870, and contains the reports of the Secretary of the Treasury and the Commissioner of Internal Revenue of the United States, a statement of internal revenue receipts for three years, the daily price of gold for nine years, the treasure movement of New York for twelve years and at San Francisco for fifteen years, price of government securities for two years, tables showing the lowest and highest sale prices each month of the leading railroad, mining, express, steamship, telegraph and other shares for five years, prices of foreign exchange each week for four years, a detailed statement of the debt of the United States, report of the Director of the Mint, table of the weights, fineness and value in American coin of the gold and silver coins of different countries, receipts and disbursements of the United States yearly since 1791, a statement of American shipping and foreign commerce, the tonnage of the United States yearly since 1789, and a list of the purchases of United States bonds by the Government. The second chapter gives in detail a statement of the debt and finances of each State. The third contains nearly 50 pages of banking statistics. The fourth is devoted to railroads and telegraphs. In this we have a review of the railroad progress of Europe and America in 1870, giving the area and population of each country, the number of miles of railroad in each, their total cost and their cost per mile; a similar statement for each State in the Union, together with a statement of the population per square mile, number of inhabitants and of square miles of area to each mile of railroad, and the percentage of increase of population between 1860 and 1870; a statement of the number of miles of railroad in the United States, and in each of five groups of States, each year since 1834; the mileage in each State each year from 1849 to 1870; statement of the length, cost, traffic and dividends of British railroads; elaborate statements of the stock, debt, earnings, expenses, dividends, etc., of the railroads of New York, Massachusetts and Ohio, and a complete statement of railroad, canal, and miscellaneous bonds, giving the companies and the character of the securities, the amount outstanding, the rate of interest, the dates and places of paying interest, and the time when the principal is due; also a similar statement concerning stocks, giving the par value, amount outstanding, period of payment of dividend, and date and rate of the last dividend paid.

The other chapters are on trade and commerce, cotton, commercial reports, a complete list of acts of Congress passed during the session of 1870, and one giving the biographies of six eminent merchants who died within the year.

The "Year Book" is an octavo volume of about 460 pages.

The Carriage Painter's Companion—Mr. John W. Masury, the well known manufacturer of painters' colors, has issued a handsome little volume of 130 pages, containining 29 sample cards, each painted with a different color, thus offering his wares for actual inspection on the pages of the book, and enabling the customer to select exactly the shade he wants. But besides these, a large part of the work is devoted to giving directions as to the best method of applying these colors, and other information especially useful to coach and car painters.

Chicago Railroad News.

Removal.

The Chicago office of Vose, Dinsmore & Co., the well-known manufacturers of car-springs, has been removed from No 15 La Salle street to 20 La Salle street, where a full stock of springs is kept. Mr. A. D. Butler, who has charge of the Chicago branch, has given his attention to the spring business for fourteen years.

Michigan Central.

After to-morrow the mail train will leave this city at 6:00 a. m. instead of 5:40 a. m. The Kalamazoo accommodation will arrive at 11:35 a. m., instead of 11:30; the day express will arrive at 7:05, instead of 8:00 p. m., and the mail will arrive at 8:05 instead of 8:25 p.m.

The company intend to lay 55 miles of its track this season with steel rails, and also to construct a large amount of second track.

Lake Shore & Michigan Southern.

We give elsewhere the report of the company for 1870.

The operating officers of the railroad were all re elected at the first meeting of the directors after their election last week.

During the meeting of the stockholders the following resolution was adopted:

Resolved, That the contract between the Cincinnati & Springfield Railway Company, Cleveland, Columbus, Cincinnati & Indianapolis Railway Company, and the Lake Shore & Michigan Southern Railway Company, under date of January 24th, 1871, be and the same is hereby approved.

At this meeting twenty-three millions out of the thirty-five millions of the stock of the company were represented and voted for the directors elected.

Illinois Central.

The company is now running a through car between this city and Fort Dodge, Iowa. The car is attached to the train leaving the Wells Street Depot of the Northwestern road at 9:00 p. m., arriving at Dubuque at 7:15 the next morning, and at Fort Dodge at 5:15 in the afternoon, making the trip in 20 hours and 15 minutes. Returning, the through train occupies but 19 hours, leaving Fort Dodge at 12:10 p. m., and arriving in Chicago at 7:15 the next morning.

The time-table on the Chicago Division will be changed next week.

Chicago & Southwestern.

Another section of the road, between Centerville and Princeton, Mo., 57 miles, is nearly completed, and the Chicago, Rock Island & Pacific Company will take charge of and commence operating it on the 1st of June. Princeton is 193 miles from the junction with the Rock Island road, and 218 miles from Davenport. Between Princeton and Trenton there remains only to lay the iron on the old grade of the Chillicothe & Des Moines Company. It is expected to have the connection completed between Chicago and Leavenworth by this line as soon as the first of August next. Between Leavenworth and Topeka the right of way and aid is being secured for the Kansas extension of the road.

Prices of Rails.

Messrs. Bigelow & Johnston, of No. 48 Pine street, New York, report as follows the prices of new and old rails during the month of April:

	Gold.	*Currency.*	*Import, tons.*
New Rails:			
English	$55½@ $56		7,835
American		$69 @ $70	
Total import this month			7,835
Import since January 1			22,780
Total to date			30,615
Same time, 1870			28,965
Old Rails:			
Double heads	$39½ @		
T or flange	39 @		1,471
U or bridge	Nominal.		
Total import this month			1,471
Import since January 1			9,586
Total to date			11,057
Same time, 1870			21,981

New Rails.—The business transacted during April has been fair, and there appears to be more inquiry.

Prices have not made any further advance, but there is increased firmness on the part of holders, justified by the gradual advance in England and contracts for forward delivery cannot be made except at our full quotations. American mills are better supplied with orders, and generally the feeling is more buoyant and hopeful. We note with pleasure a steady extension of the manufacture of steel rails by the Bessemer process here, which bids fair to become one one of our permanent industries.

Old Rails.—The arrivals are again very light, and with a steady demand prices are well maintained, with large sales for forward delivery.

—A proposition to submit the question of paying the old railroad bonds of Minnesota to arbitration was submitted to a vote of the people last week, and defeated by a considerable majority.

General Railroad News.

OLD AND NEW ROADS.

Detroit, Lansing & Lake Michigan.

The Greenville (Mich.) *Independent* says that work is progressing rapidly on the extension of the Western Division of this road, from Greenville northwestward. It is to cross the Grand Rapids & Indiana road, probably, either at Howard City, 33 miles north of Grand Rapids, or at Reynolds, two miles further north.

Hannibal & St. Joseph.

Mr. Edward Wilder, Land Commissioner of the Hannibal & St. Joseph Railroad Company, reports that the company's sales of railroad land in North Missouri, for the mouth of April, were, to 40 purchasers, 2,159 90-100 acres, for $26,291.89, or an average of $12.17 per acre.

Winona & St. Peter.

Mr. Stewart, the General Superintendent, advertises for proposals for leasing the station work and all or either of the grain warehouses and elevators belonging to the company, and located at the following named places: Winona, Lewiston, St. Charles, Eyota, Rochester, Kasson, Claremont, Owatonna, Waseca, Janesville and Mankato.

The leases will run one year from June 1, 1871, and may be for a term of years, if satisfactory contracts can be made. No exclusive privileges or preferences of shipments or storage at any place will be conveyed to the lessees.

The leases will be made, and the business under them must be conducted subject to the rules and regulations of the company.

Iowa, Minnesota & North Pacific.

Votes will be taken in Newton and Palo Alto townships, in Jasper County, next week, on the question of levying a five-per-cent. tax in aid of this road. This company is formed, we believe, to build a portion of the proposed line of the Burlington & Northwestern Company.

Minnesota Railroads.

The St. Paul *Press* gives the following table of mileage of roads in operation in Minnesota at the close of 1870, mileage to be constructed in 1871, and mileage planned to be constructed after 1871:

NAMES OF ROADS.	Miles completed in 1870.....	Miles to be built in 1871.....	No. of miles projected in Minn. after 1871.....
Northern Pacific	50	180	.
St. Paul & Pacific (main)	135	80	..
St. Paul Brainard branch	76	70	..
St. Paul Otter Tail branch	..	..	80
St. Paul Pembina extension	..	..	140
St. Paul & Sioux City	122	50	94
Milwaukee & St. Paul	146	..	..
St. Paul & Chicago	55	41	..
Lake Superior & Mississippi	154	..	..
Hastings & Dakota	28	20	186
Winona & St. Peter	130	30	76
Southern Minnesota	170	..	100
Stillwater & St. Paul	12	..	..
Minnesota & Northwestern	..	47	90
St. Paul, Stillwater & T. F.	..	18	..
Dubuque & St. Paul	..	..	130
Minnesota & White Bear	..	13	..
Minnesota & St. Louis	..	..	25
Total	1087	549	921

Toledo, Thornton & St. Louis.

There has been a reorganization of this company, and it is reported that surveys will be made immediately, and a strong effort made to construct the road. The general route of the road through Indiana appears to be west by south through Decatur, Bluffton, Marion, Tipton, Thornton, and Crawfordsville.

Bedford & Bridgeport.

This Pennsylvania company has recently made an agreement with the Pennsylvania Railroad Company by which the former company is to grade and bridge its road from Mount Dallas, the present southern terminus of the Huntington & Broad Top Branch of the Pennsylvania Railroad, southwestward about 30 miles to Bridgeport, on the Pittsburgh & Connellsville Railroad about eight miles from the Maryland line. The Pennsylvania Railroad Company is then to complete the road, receiving therefor the other company's bonds. The Pennsylvania Company further agrees to extend the road to the Maryland line within three years, in the direction of the Cumberland coal mines, provided that a road shall be built from those mines to meet them. It is believed that the new road will be in operation to Bridgeport by the end of next summer.

Jacksonville, Pensacola & Mobile.

General Littlefield, President of this company, as well as of the Florida Central Company, announces that arrangements are now complete by which the iron for the extension to the Chattahoochie River will be shipped immediately, and he promises the rapid completion of the road to Mobile. The Quincy *Journal* says: "A line of steamers from New Orleans has already been arranged for to connect with the steamers at Apalachicola, and, also, communication will be renewed to St. Marks. The road will then be extended to deep water at the Spanish Hole."

Muscatine Western.

Muscatine is to vote on the question of subscribing a 5-per-cent. tax to this road on the 17th inst. Pike township voted a 5-per-cent. tax on the 5th inst. The township of English River, in Washington County, has voted against the tax asked.

Cincinnati & Dayton Short Line.

The company have signed a contract for the use of the seven or eight miles of road which the Cincinnati & Baltimore Company are building, from Spring Grove Junction to the Cincinnati & Indianapolis Junction Railroad. This short piece of road was projected to afford the Marietta & Cincinnati Railroad an independent entrance to Cincinnati. The Short Line Company will pay an annual rental of $35,000 for its use.

Louisiana & Missouri River.

A Louisiana, Mo., correspondent of the St. Louis *Republican* says: "In a few days the laying of track upon the line of the railroad from this city to Kansas City will be resumed. The main line from this city to Mexico, Mo., is now ready for the iron, and by the time that can be laid, the road-bed from Rood House, Ill., to this city, and the branch from Mexico to Jefferson City, will be completed, and the laying of track will be continued without interruption, so that by the first of September we may reasonably expect that the road from Jefferson City to Rood House will be opened to the public."

Cairo & Fulton.

The iron for the 12 miles between Cairo and Charleston is at hand, and this portion of the line is to be relaid at once. Mr. Thomas Allen, President of the company, was last week inspecting this portion and the extension westward, and ordered a survey and location to be made of a line west from Charleston to connect with the Arkansas Branch of the Iron Mountain road.

Kansas Pacific.

The company has issued a very handsome circular, which, with abundance of advertisements of the route and connections, and a map from Kansas City to San Francisco, gives a table of stations, the distances of each from Kansas City, the elevation of each above the sea, and the arriving and leaving time of all trains at each, on this long line. It is thus of value to the traveler and likely to be preserved by many besides for the information it gives.

R. S. Elliott "Industrial Agent" of this company, publishes in detail the results of experiments with different trees, grains, grasses, vegetables, etc., on "the plains," which are now for the most part desolate. He makes the following conclusions:

I. Experience already warrants the belief that we may grow on the plains, without irrigation—

1. Lucerne and other vegetable forage plants;
2. Winter and spring grains;
3. Trees from seed as far west as the one hundredth meridian, and probably to the mountains.

II. Experiments now in progress justify the faith that trees from seed, cuttings and young plants, may be grown for timber, fuel and fruit in all parts of the plains between the Platte and the Arkansas rivers.

III. The growth of living storm shields along the line of the Kansas Pacific Railway, and of timber for the uses of the road, is only a matter of effort and time. Respectfully submitted.

Des Moines & Winterset.

Des Moines township has voted a tax of one per cent. to aid the road. With this vote, the company has, we believe, secured all the aid asked to build the 30 miles of road southwest to Winterset.

Paris & Decatur.

The annual election was held on Monday the 3d of April at the office of the company in the city of Arcola. D. Hitchcock was elected President; W. T. Sylvester, Vice-President; Lucius McAlister, Secretary, and Jacob Willis, Treasurer. The route of the road extends from Paris, in Edgar County, to Decatur, in Macon County. Thirty miles is graded, and the balance of the work is being rapidly pushed forward. The iron is purchased for the entire line, and the road is to be completed and equipped with the necessary rolling stock and fixtures by the 1st day of January, 1872.

Sheboygan & Fond du Lac.

It is intended to extend this railroad westward this season from Fond du Lac to Ripon, a distance of 22 miles.

Evansville, Henderson & Nashville.

The company's machine shops and round-house at Hopkinsville, Ky., are to be built at once. A delay in the commencement of the work has been occasioned by the refusal of the owners of the property to accept the award of the County Commissioners for the land to be occupied.

Missouri, Kansas & Texas.

The contract for grading the last seventeen miles of the road to the Arkansas River, at or near Fort Gibson, has been let to Mr. Samuel Fry. Mr. Fry has already graded sixty-seven miles of the road, and is to have this last contract finished before the 1st of June. About 90 miles in the Indian Territory are now graded, and it is expected to have one hundred and sixty-five miles south from the Kansas line finished by October next.

Sabula, Ackley & Dakota.

The Marion *Register* learns that the company are pressing matters both east and west of Marion, and expect to have the road completed to that place, and perhaps twenty miles beyond, the present season. Votes on the question of township aid have been ordered in townships in Grundy and other counties.

Ottawa, Oswego & Fox River Valley.

A meeting of stockholders who subscribed in order to secure the construction of this road through the towns in which they live, was held in Ottawa on the 4th inst., and appointed a committee to ascertain what rights they have since the road has been leased to the Chicago, Burlington & Quincy Company.

Indiana & Illinois Central.

We learn that the new organization has the means and the determination to construct this railroad (Indianapolis, Ind., to Decatur, Ill.) Mr. J. E. Condict (not Condi as the telegram copied in the GAZETTE had it last week), of the firm of Condict & Co., bankers, New York, has a large interest in the road.

Pennsylvania & Sodus Bay.

This company advertises for proposals for the construction of its road, 54 miles long, extending from a junction with the Athens & Tioga Railroad at Spencer, in Tiogo County, N. Y., northward between Cayuga and Seneca lakes to Waterloo, on the old line of the New York Central, about twenty miles west of Auburn. This road is to have a 3-feet gauge. The Chief Engineer is Alfred H. Sears, whose office is at Seneca Falls, New York.

Atchison, Topeka & Santa Fe.

Col. T. J. Peter, the General Manager, advertises for proposals for the grading and masonry of thirteen sections from Parnell's (a point on the Central Branch Union Pacific road 7 or 8 miles southwest of Atchison) south, and ten sections from Topeka north; proposals to be received at the company's office in Topeka until 4 p. m., May 24. These sections will complete the road from Topeka to Atchison. It is in operation for about 80 miles southwest of Topeka, but now depends entirely on the Kansas Pacific for an outlet.

Shepang Valley.

The bonds, amounting to $350,000, of this Connecticut Railroad have all been taken, and the road is to be completed by September. It will extend from Litchfield, Conn., southwest about 30 miles to Hawleyville, on the Housatonic Railroad, 23 miles north of Bridgeport.

Sioux City & Pacific.

Under the act of July 2, 1864, the Sioux City & Pacific Railroad, connecting with the Union Pacific Railroad, received land grands and bonds from the United States, and the Union Pacific was released from the construction of that branch. The question arose whether or not the Sioux City & Pacific Railroad were required to pay one-half of the compensation for services rendered to the government in aid of its construction, as provided by the fifth section of the act of July 2, 1864, in the case of the Union Pacific. The Quartermaster-General referred the matter to Comptroller Brodhead, who decided that the conditions which obtain in the Union, Central and Kansas Pacific Railroad companies, in this regard, apply also to the Sioux City & Pacific Railroad, and that its amounts for government transportation must be settled in the same way and on the same terms.

Fort Dodge & Minnesota.

A report is published that this company has obtained the necessary means and will commence work about the first of June.

Wisconsin Railroads.

The Madison (Wis.) *Journal* says: "Railroad enterprises are getting to be pretty numerous in the northern part of the State. The Green Bay & Lake Pepin Railroad, and the Doty Island & Stevens' Point (Wisconsin Central) Railroad, are already in process of rapid construction. Besides these, the Sheboygan & Fond du Lac Railroad is about to be extended to Ripon and westward, and now the construction of the Manitowoc, Appleton & New London Railroad is about to be undertaken. The Hon. Hiram Barney, writes to Judge Ryan, of the Appleton *Crescent*, as follows: "I have been expecting to see some notice in your paper of the Appleton & New London Railway. It is now about two weeks since arrangements were completed for the requisite funds to build the road. The iron is purchased and part of it has been shipped. You may be pretty sure of welcoming an iron horse from Manitowoc before the 1st of next October."

Cincinnati, Hamilton & Dayton.

The following statements of the business of the road for the year ending March 31, 1871, taken from the report made at the annual meeting on the 9th inst., are reported by telegraph: The gross earnings for the year ending March 31 were $127,621.98; transportation expenses, $627,295.93; leaving a balance for interest on bonds, taxes and dividends of $643,376.05. Passengers carried, 753,787; tons of freight moved on the narrow-gauge cars, 48,603. The net earning have been 12 68-100 per cent., out of which two cash dividends of 4 per cent. each have been paid to the stockholders. The surplus account now is $539,874.51.

Leavenworth, Lawrence & Galveston.

A thousand men are at work on the extension of this road from Thayer westward.

Missouri, Kansas & Texas.

The Fort Scott (Kan.) *Monitor* says that the survey of this railroad line in Texas is completed from Preston, on Red River, where the line leaves the Indian Territory, to Austin, crossing the Brazos River at Waco.

Atlantic & Pacific.

The contract for the construction of this company's branch from Dayton, Mo., to Baxter Springs, Kan., has been let to the Mississippi Construction Company.

Boston, Hartford & Erie.

In the matter of the Boston, Hartford & Erie Railroad, the Massachusetts Supreme Court has decided that Moses Kimball, Thomas Talbot and Avery Palmer are the legitimate successors of the original trustees under the Berdell mortgage, and, upon their complying with certain specified conditions, the receivers are to place in their hands the property and franchises of the company.

Plymouth, Kankakee & Pacific.

The contracts for the part of this road in Indiana are soon to be let, and it is expected that track-laying will begin at Plymouth (where connection is made with the Fort Wayne road) in June, and that the road will be in operation as far west as Dwight, on the Chicago & Alton, by the end of this year. It is to be equipped and operated by the Pennsylvania Company, and for the encouragement of those who have reported that the latter company is likely to obtain control of the Rock Island road, it may be said that a very short

route from New York to Omaha, 33 miles shorter than that by way of Chicago, may be made by using this new road in connection with the Rock Island west of Bureau Junction.

Burlington & Missouri River.

An officer of the road writes us from Plattsmouth: "We are progressing westward with our track (now 62 miles from here) at the rate of from one-half to one mile per day. Our main line from De Witt (84 miles from Plattsmouth) to Fort Kearney, being 107 miles, has been let, as regards grading, to John Fitzgerald, while the truss bridging has been awarded to Wells, French & Co., of Chicago. We expect to be running to the Platte River, in the vicinity of Fort Kearney, by the 1st of January, 1872."

Shenandoah Valley.

At the last meeting of the company a resolution was passed that the work of construction upon the part of the road located within the limits of the County of Jefferson be begun as soon as practicable. The headquarters of the company have been established at Front Royal.

ELECTIONS AND APPOINTMENTS.

—The following were chosen members of the Board of Directors of the Toledo, Thornton & St. Louis Railroad Company at a special meeting held in Indianapolis on the 9th inst.: M. A. Dent, Decatur, Ind.; J. C. Silver, Bluffton, Ind.; S. S. Goode, Warren, Ind.; Thomas S. Sprague, Detroit, Mich.; N. P. Garren and Robert Cox, Thornton; Colonel Samuel C. Wilson, Crawfordsville; S. A. Hough, Lafayette; Charles W. Green and George Butler, New York; John B. Tipton and A. M. Vickers, Tipton. Thomas S. Sprague, of Detroit, was chosen President.

—The Delaware & Hudson Canal Company re-elected its old Board of Directors on the 9th inst.

—John H. Gear, a prominent merchant of Burlington, Iowa, has been chosen President of the recently organized Burlington & Northwestern Railroad Company.

—Mr. George S. Bangs, late Special Agent of the Railroad Postal Service for the Northwest, for eight years before that Postmaster at Aurora, Ill., and formerly publisher of the Aurora *Beacon*—one of the best country papers in the Northwest—has been appointed Superintendent of Railway Postal Service for the United States, in place of George B. Armstrong, deceased.

—The stockholders of the Louisiana & Missouri River Railroad Company held their annual meeting at Lousiana, Mo., on the 1st of May and elected as directors: H. V. P. Block, Aaron McPike and J. E Corsterphew, of Pike County; John W. Reid and Samuel L. Sawyer, of Jackson; M. V. L. McClelland of Lafayette; D. Landon, of Saline; Thos. Shackelford and J. P. Sebree, of Howard; R. B. Price, of Boone; Chas. H. Hardin, of Audrain; Wm. King and D. M. Tucker, of Callaway, and J. J. Mitchell and R. P. Tansey, of the Chicago & Alton Company. Mr. H. V. P. Block was re-elected President; John W. Reid was elected Vice President; W. F. Colton was re-elected Secretary and J. S. Brown was elected Treasurer.

—The annual meeting of the stockholders of the Kansas Pacific Railroad Company was held at Lawrence, Kansas, May 4. John D. Perry, Adolphus Meier, Robert E. Carr, C. S. Greeley, Wm. McPherson, B. W. Lewis and S. M. Edgell, of St. Louis; Thomas A. Scott and M. Baird, of Philadelphia; William Thaw, of Pittsburgh, and John McManus, of Reading, Pa., were elected directors of the company. Of these, Robert E. Carr, B. W. Lewis, M. Baird and William Thaw are new members, succeeding William J. Palmer, of St. Louis; Thomas L. Price, of Jefferson City, Mo.; H. J. Jewett and William H. Clement, of Cincinnati. The new board was organized by the election of Robert E. Carr, President (in place of John D. Perry); Adolphus Meier, Vice-President; C. S. Greeley, Treasurer, and Chas. B. Lamborn, Secretary.

—At the annual meeting of the stockholders of the Vicksburg & Meridian Railroad Company, held in Vicksburg May 1, the following persons were elected members of the Board of Managers for the ensuing year: Morris Emanuel, A. B. Reading, Thomas Rigby, Peter Anderson, Wm. E. Morris, Wm. Crutcher, John A. Klein, John C. Stanton, Thomas M. Smedes, Thomas S. Dabney, James R. McDowell. The new board proceeded to the election of officers of the company for the ensuing year, as follows: Morris Emanuel, President; Thomas Rigby, Vice-President; N. G. Bryson, Secretary and Treasurer. An Executive Committee was also elected for the year, consisting of M. Emanuel, Thomas Rigby, Wm. E. Morris and Wm. Crutcher. In this board Messrs. Klein and Stanton are new members, succeeding Adelbert Ames (now United States Senator from Mississippi), and D. W. Flowerree, a Vicksburg merchant. Mr. Stanton is a director of the Alabama & Chattanooga Company.

—At the annual meeting of the Cincinnati, Hamilton & Dayton Railroad Company held in Cincinnati on the 9th inst., the following directors were elected: Daniel McLaren, John Young, S. S. L'Hommedieu, Wm. Goodman, Geo. S. Steadman, Samuel Fosdick, H. D. Huntington, Lowell Fletcher, Charles W. West. These are all re-elections except Charles W. West, who takes the place of William Beckett.

—At a meeting of the stockholders of the Shenandoah Valley Railroad Company at Charlestown, Virginia, on the 18th ult., Col. Thos. A. Scott, of Philadelphia, was unanimously elected President, and Messrs. J. M. Walker, William Painter, George H. Bardwell, B. J. Jemison, of Philadelphia; Hon. A. R. Boteler, W. H. Travers, of Jefferson County, Va.; A. W. McDonald, of the County of Clark; Hon. Wm. Milnes, Jr., Peter B. Borst, M. Spitler and J. W. Ashby, of Page County, Va., were elected directors.

—C. C. Cobb has been appointed General Passenger Agent of the Cleveland, Columbus, Cincinnati & Indianapolis and the Indianapolis & St. Louis railroads, in place of E. A. Ford, resigned. Mr. Ford, according to the telegraphic report, goes to the Missouri Pacific.

—Mr. C. Harris, formerly of the Boston & Worcester Railroad and for some time past Superintendent of the Western Division of the Lake Shore & Michigan Southern Railway, has been appointed General Superintendent of the Wisconsin Central Railroad now in process of construction.

—C. S. Woodard has been appointed Chief Engineer and Master of Roadway of the Fort Wayne, Muncie & Cincinnati Railroad; J. J. Grafton General Ticket Agent; A. H. Stewart, Superintendent of Bridges; D. R. Donnell, Superintendent of Telegraph, and J.C. Brinsley, Train Dispatcher and Master of Transportation. All have their offices at Fort Wayne, where the company's headquarters were established on the 1st inst.

—S. J. Brodwell was on the 4th inst. chosen President of the Cincinnati & Indiana Railroad Company, which owns the Ohio part of the Indianapolis, Cincinnati & Lafayette Railroad.

—The stockholders of the Ohio & Michigan Railway Company met at the company's office in Coldwater May 10 and voted unanimously to consolidate the two branches, after which the consolidated company elected the following directors: H. C. Lewis, J. G. Parkhurst, J. V. Smith, John S. Yount, L. S. Youngs, of Coldwater; V. P. Collin, T. B. Skinner, of Battle Creek; Joseph Fisk, of Allegan; W. S. Hickox, H. Colby, H. H. Stuger, T. B. Burns, J. H. Cook, and A. L. Grimes, of Ohio.

PERSONAL.

—A short time ago, Mr. C. F. Jauriet, Master of Machinery of the Chicago, Burlington & Quincy Railroad, was waited upon at the shops in Aurora by a deputation of the locomotive engineers, firemen and roundhouse men who presented him, through Mr. H. R. Torrey, Foreman of the Round-house, a handsome family carriage, a pair of fine carriage horses, and an elegant harness, costing altogether a thousand dollars or more. Mr. Torrey made a neat little speech expressive of the good will and esteem which this magnificent present was intended to indicate.

—Mr. John Porter, Attorney and Financial Agent of the St. Louis & St. Paul Railroad Company, has been suspended from office pending the investigation of his management of the affairs of the company.

—George B. Armstrong, Superintendent of the Railway Mail Service of the United States, died at his residence in Chicago on the 5th inst. Mr. Armstrong was in the service of the Post Office Department most of the time after 1854, having been at one time Assistant Postmaster at Chicago, and long Special Agent of the of the department. He introduced the present system of postal cars and distribution on cars while in transit, which are most important improvements in the postal service, and materially increase rapidity of transit.

—David Reeves, one of the great iron manufacturers of America, long President of the Phœnix Iron Works, died at his residence in Phœnixville, Pa., last week, aged 79 years.

—Many employes of the Kansas Pacific Railway visited Mr. W. H. Bancroft, the Master of Transportation, last week, and presented him with an elegant gold watch. At the same time the operators along the line gave a nickle-silver tea service of great splendor to their Superintendent of Telegraph, Mr. O. H. Dorrance.

Lake Shore & Michigan Southern Railway Report for 1870.

We give below a condensation of the report of the President of the above company for the year 1870, read at the stockholders' meeting in Cleveland on the 3d inst. by Mr. C. P. Leland, the Auditor. It will be remembered that no report in detail was made for 1869, the company having been formed during that year by the consolidation of four different organizations. The abstract of the report below is taken from a Cleveland paper:

The first part of the report was devoted to a history of the organization of the company, which is a consolidation of several, forming a continuous line of railway from Buffalo to Chicago, 540 miles in length. The company owns and controls branches as follows: Elyria to Sandusky, 35 miles; Oak Harbor to Millbury, 15; Toledo to Elkhart, Ind., 133; Adrian to Jackson, Mich., 46, and Adrian to Monroe, Mich., 34 miles. The following roads are under separate organizations, but the capital stock thereof is owned wholly by this company: Detroit, Monroe & Toledo, 65 miles, and the Kalamazoo & White Pigeon, 37. The Jamestown & Franklin road, 51 miles, is operated by the company under a lease. It is contemplated, at an early day, to construct this line from Jamestown to Ashtabula. The Kalamazoo, Allegan & Grand Rapids road, 58 miles, is also operated under a lease. The whole number of miles owned and leased by the company is 1,014.

The company has 34 miles of double track, mainly between Erie and Cleveland, and 233 miles of side tracks.

During the past year 25 new engines and 601 cars have been added to the equipment of the road, at a cost of $654,309.45. The present equipment consists of 299 engines, 247 passenger cars, and 6,077 freight cars.

The authorized capital stock is $50,000,000, of which sum $35,000,000 has been issued to the stockholders of the various companies entering into the consolidation, leaving $15,000,000 which can be issued only by authority of a previous vote of the stockholders.

The bonded debt of the company amounts to $22,283,000, the annual charge for interest on which is $1,561,810, the rate being seven per cent. on all except $200,000, which is eight per cent. Of this debt, nineteen classes of bonds are secured by mortgages on distinct portions of the road.

The company last July executed a consolidated mortgage, with a provision for a sinking fund, to secure the payment of bonds, registered and coupon, to the amount of $25,000,000, bearing seven per cent. interest. Of the bonds secured by this mortgage a sufficient amount has been set apart to secure the payment of the bonded debt at maturity and the proceeds of the residue will be appropriated to double-tracking the main line and procuring additional equipment.

The earnings for 1870 were:

From freight	$8,658,661 81
From passengers	4,153,512 11
From all other sources	645,366 94
Total	$13,457,540 86
Operating expenses, including taxes, 62 1-5 per cent.	8,368,821 08
Net earnings	$5,088,719 78
Interest on bonded debt and guaranteed stock, leases, etc	$1,777,262 42
Dividends—2 of 4 per cent. each	2,752,300 00
Total	$4,529,562 42
Surplus for the year	$559,157 36

There has been built at Elkhart, Ind., a machine shop 600x120 feet, with a blacksmith shop 100x72 connected therewith, at a cost of $141,881.26. This has enabled the company to dispense, substantially, with the machine shops at Adrian and Laporte. The machine shop at Adrian has been appropriated to the car department, and the shop at Laporte has been discontinued. This has resulted in the saving of a large annual outlay and in greatly increased facilities for the transaction of business.

New depots and other structures have been built at a cost of $139,567.57. Additional second and side tracks (34 miles) have been constructed at an expense of $314,406. The expense for bridge masonry and permanent embankment was $391,039.93; of miscellaneous construction, $39,449.65.

During the year 18,661 tons of new and rerolled rails, including 3,054 tons of steel rails, have been laid. It has been determined to construct during the present year 114 miles of additional double track between Buffalo and Toledo.

The Board of Directors recognize the great ability and fidelity with which Mr. J. H. Devereux, the General Manager, and the other officers of the company have discharged their several duties, and attribute to their efforts the successful results of the year.

The earnings of the road for the first four months of the year 1871 show an increase of $393,000 over the corresponding period of last year.

RAILROAD LAW.

Accord and Satisfaction.—*A receipt in full being given to a railroad company for damages, an injunction will not lie to prevent the pleading of such receipt in accord and satisfaction, notwithstanding the injuries proved to be much more serious after the giving of the receipt.*

The Lord Justices of Appeal in England have recently decided a curious case (*Lee vs. Lancashire & Yorkshire*) of which the following is the substance:

The plaintiff, Mr. Thomas Vincent Lee, was a civil engineer living at Macclesfield. On the 25th of September, 1865, he was a passenger on the defendants' line between Manchester and York, when an accident occurred to his train. The plaintiff was stunned by the shock, and was removed in that state to a hotel in Manchester. Dr. Clayton was immediately summoned, it was uncertain by whom, but presumably by a railway official. Afterwards Dr. Midwood (the medical officer to the company) visited him, and also his own family doctor, Dr. Sandford, of Macclesfield. The doctors consulted, and assured him that his injuries were not permanent, but that he would be about again in three or four months. Relying on this, on the 11th of October he sent in a claim to the company, stating his own fear that his injuries were permanent, but that, trusting to the more favorable opinion of the doctors, he would confine his claim to £5 a-day for ninety days, or £450, making with £240 for doctors' bills and other expenses, £690 in all. It appeared from the correspondence produced by the defendants that at this time Dr. Clayton wrote to Dr. Midwood, as representing the company, as to his charges, and advised him to settle with Lee as soon as possible, as his was a doubtful case. On the 18th of October Dr. Midwood and Mr. Blackmore (the Traffic Manager of the company) called on the plaintiff, by order of the directors, and induced him to accept £400 and payment of his medical expenses in discharge of his claims; but, according to his account, he only signed the receipt for the money on the understanding that if his injuries turned out to be more serious than they were then supposed to be, he would not be precluded from recovering further compensation from the company. The receipt which the plaintiff signed was expressed to be "in discharge of my claim "in full upon the company, for all losses sustained and "expenses incurred by the late accident at Miles Plat-"ting, September 25, 1865, including all expenses at-"tending same." According to the plaintiff's account, he in July, 1866, became much worse, and for many months lost his hearing and his power of speech, which, however, he in April, 1867, suddenly recovered. He claimed further compensation from the company, and ultimately brought an action for £3,000, to which they pleaded that the plaintiff had accepted the £400 in full satisfaction and discharge of the cause of action. The plaintiff filed the bill in this suit, asking for an injunction to restrain the company from relying on this plea, and from using the receipt as a defense to the action. The Vice-Chancellor granted an injunction, and the company appealed.

Upon this state of facts the court adjudges that the plaintiff was not entitled to the relief sought and says:

"The plaintiff in this case was a gentleman of education, a man of skill, and fully capable of taking care of himself, and of understanding what was done. He sent his claim to the company on the 11th of October, 1865, and this appeared to have been the first occasion on which the company considered the amount of compensation which should be given to him. The claim came from him; the company did not take advantage of his position to make him an offer. A report was made to them by their medical officer, and they then sent their Traffic Manager, Mr. Blackmore, to the plaintiff, who had a conversation with him, the result of which was that he agreed to accept the £400, and signed the receipt for it. The Vice-Chancellor said that the company were snatching at a compromise, having some knowledge about the plaintiff's state which they ought to have communicated to him. His lordship could find no evidence to show that the directors of the company or their officials did anything but what honorable men might have done in a matter of business of this kind. The bill did not even allege that there was any fraud on the part of the company or their doctor, or that they were guilty of any concealment from the plaintiff. The plaintiff's case really was that the £400 was only paid in respect of the injuries then known, and that he was to have a further claim against the company if his injuries turned out more serious than they were then supposed to be, and his equity was that he was induced to sign the receipt upon a representation by Mr. Blackmore that he would not be precluded from demanding further compensation if his injuries proved to be more serious. That case would be much more satisfactorily dealt with by a jury than by this court. His lordship was bound to say that if he had to decide it on the evidence now before him he should not find enough to satisfy him that the plaintiff did not intend the receipt to operate according to its words. But he wished to leave that question entirely open to a jury. The plaintiff's case on this bill wholly failed, and the bill must be dismissed."

Rule Concerning Negligence in Starting Trains.

In the case of *Curtis et al. vs. Detroit & Milwaukee Railroad Company*, the Supreme Court decided the following general principles:

"1. Where a complaint against a railroad company for injuries to plaintiff's person alleges that they were caused by defendant's negligence in starting the train while plaintiff was getting upon it, without giving him sufficient time for that purpose, and defendant alleges that the plaintiff was negligent in getting upon the train when he did, facts showing the company's negligence in other respects than that charged, and not tending *directly* to produce the injury, are admissible in evidence against it, if they tend to show that under the actual circumstances it was not negligent for plaintiff to get upon the train at the time and in the manner proven.

"2. The train being a night train with sleeping car attached, it was not error to refuse to instruct the jury that plaintiff's attempting to get aboard *before the sleeping car was abreast of the platform* was negligence *per se*; it not appearing that plaintiff knew the length of the train as compared with the platform, or ought to have assumed that it was intended to bring the sleeping-car to that position.

"3. An instruction that 'if plaintiff, in taking the train, acted as persons of common sense and ordinary prudence and intelligence usually act in like cases, there was no such negligence on his part as will prevent a recovery by him in this action'—*held* not erroneous.

"4. An instruction that if, under the circumstances of this case, the train, in being brought up to the station, came to a stop in such a manner as to induce the belief, on the part of passengers waiting on the platform, that it had stopped for their reception, and then, when they, acting on this belief, were going aboard, started again without caution or signal given, this would be an act of negligence on the part of the company, whether or not the starting was one of necessity, and whether the stop was an actual or only an apparent one—*held* not erroneous. It was the duty of the company, if the passengers were not to enter the car under these circumstances, to have some one there to warn and prevent them, and of the persons in charge of the train, not to start it without previous caution or signal given."

Liability of Railroad Companies to Employees.—*One servant cannot recover against the common master for injuries resulting from the carelessness of a fellow-servant, if the master has used due diligence in their selection.*

In the recent case of *The Chicago & Alton Railroad Company vs. Keefe*, the Supreme Court of Illinois reaffirms the position already taken in *Homer vs. Ill. Cent. R. R. Co*, 15 Ill., 550; *Ill. Cent. R. R. Co. vs. Cox*, 21 Ib., 20, and *Moss vs. Johnson*, 22 Ib., 633, which was to the effect that one servant cannot recover against the common master for injuries resulting from the carelessness of a fellow-servant, if the master had used due diligence in their selection; and the Court adds that this question must be considered forever settled in Illinois. The circumstances of the case were these: It appears, by the record, that while the plaintiff was engaged in unloading railroad iron from a platform car, the conductor of the train went up the embankment to watch for an approaching passenger train, and signaled to the engineer to back the construction train in order to run on to a switch. The engineer backed without giving the preliminary whistle, as required by the rules, and the plaintiff was thrown from the platform car where he was at work. The record shows that the train, and all the persons upon it, were under the control of the conductor, and not of the engineer, and that this accident, so far as it is chargeable to the carelessness of any one, was due to that of the engineer, who started the train without giving the signal required by the rules. There is no pretense for charging the conductor with negligence, and he was the only person on the train to whom the plaintiff was in subordination.

The Slide Valve.—I.

BY C. DRAPER, A. B., L. C. E.

Many ingenious forms and arrangements of valves have from time to time been devised for the purpose of admitting the steam to and withdrawing it from the cylinder of a steam engine, in such a manner as to move the piston alternately backwards and forwards between the extremities of its stroke; but as none have come into nearly so extensive application as the slide-valve actuated by an eccentric, we purpose in a series of articles to place before the readers of the *English Mechanic*, we hope, a tolerably complete explanation of this simple and beautiful device.

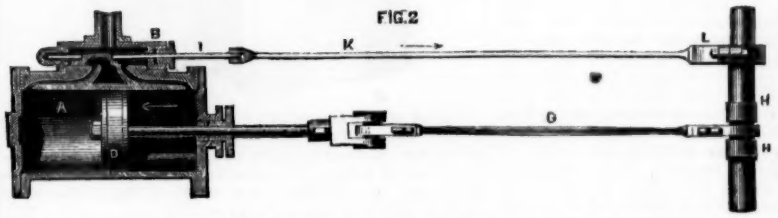
That the whole subject of valves and their gearing is an all-important one to the mechanical engineer few will doubt, as upon it depends in a great measure, as far as the engine is concerned, the economical consumption of steam, and therefore of fuel.

To render the subject clear to those who now study it for the first time, we shall commence by giving a general explanation of the leading features of a horizontal stationary steam engine, particularly those of the valve gear, before entering upon the details of our subject.

Fig. 2 is a sectional plan through the center line of the cylinder, showing the cylinder *A*, the valve-chest *B*, and the slide-valve *C*, in section, and the piston *D*, the piston rod *E*, the connecting rod *G*, the crank *H*, the valve rod *I*, the eccentric rod *K*, and the eccentric

FIG. 1.

FIG. 2



L, in plan. Fig. 1 is a side elevation of the cylinder, etc., from which the valve-chest, slide-valve and cylinder have been removed, thus showing the parts *P Q*. The same letters are used in both figures to indicate the same parts. We shall now endeavor to accurately define and describe all these different parts, which must be thoroughly understood before the slide-valve itself is described. It should be borne in mind that the following definitions have special reference to the type of engine drawn in Figs. 1 and 2, since there are at the present day so many varieties of the steam engine that these definitions may not strictly apply to all. If, however, the reader thoroughly understands the details of this very common description of engine, he will have but little difficulty in comprehending those of any other.

The cylinder is the chief part of a steam engine, and is that in which the steam acts upon a movable piston, which is forced alternately to each end. The cylinder which is drawn in Figs. 1 and 2 is double-acting; that is to say, in it the piston is urged in either direction by the pressure of the steam, and the steam having done its duty is suffered to escape into the condenser or atmosphere, according as the engine is condensing or non-condensing. A part of the outside of the cylinder is cast flat and brought to a truly plane surface; in it are the openings of three passages, of which the outside ones communicate to the ends of the cylinder, and the central one to the atmosphere or condenser, as the case may be. The former are called the "steam ports," and the latter the "eduction" or "exhaust port." The slide-valve works over these ports, and is covered by the "valve-chest" or "casing."

The "piston" is a short solid cylinder, moving steam tight in the cylinder of the engine; the length it travels, or the distance between its extreme positions, is called the "stroke," therefore the internal length of the cylinder must be equal to the stroke, together with the depth of the piston and twice the "clearance," which is a small distance allowed between the piston and either end of the cylinder at the end of each stroke.

The "piston rod" is a cylindrical rod, one end of which is secured to the piston and the other engages one end of the connecting rod. It is made to pass steam-tight through the cylinder cover by means of a gland and stuffing box, as shown. The "connecting rod" is a rod which derives its name from connecting the end of the piston rod with the crank-pin. One end of it therefore moves in a right line, whose length is equal to the stroke of the piston, and the other in a circle whose diameter is equal to the stroke of the piston.

The "crank" is the contrivance for converting the rectlinear motion of the piston into circular motion, which is that most required; it consists of two arms parallel to each other, projecting at right angles from the main shaft of the engine, hence called the "crank-shaft"; the shaft is cut away between these arms and their ends are connected by a pin called a "crank-pin," which is parallel to the shaft, and is engaged by one end of the connecting rod. The "throw" of the crank is the distance between the centers of the shaft and crank-pin, and as the shaft revolves the crank-pin must describe a circle whose radius is equal to the throw of the crank, and from the above description of the connecting rod, it will also be clear that twice the throw of the crank, or the diameter of the circle described by the crank-pin, must be equal to the stroke of the piston.

It will be seen that as the crank-pin revolves there are two positions in its circular path in which it lies in the axis of the cylinder produced; these points are called the "dead points."

The usual method of measuring the stroke of the piston of a steam engine is to measure the throw of the crank, and take twice this distance.

The "eccentric" consists of a circular disc, usually of cast-iron, in which a hole is formed, through which the crank-shaft passes, but the center of this hole does not coincide with the center of the disc. The eccentric is caused to rotate with the shaft either by being permanently keyed to it, or by means of a projection on it coming in contact with a stop fixed on the shaft. The distance between the centers of the eccentric and shaft is variously called the "eccentricity," the "eccentric arm," the "eccentric radius," or the "throw." As the eccentric revolves it is evident that its center describes a circle round the center of the crank shaft, whose radius is equal to the throw. In fact, the movement produced by an eccentric is exactly the same as that of a crank, the throw of which is equal to the throw of the eccentric; this will be easily seen by comparing an eccentric to a crank having a small throw and a very large crank pin.

Some writers on the steam engine define the throw as the diameter of the circle described by the center of the eccentric; it is, however, a matter of very little consequence whether the diameter or radius be called the throw, provided that one definition be adhered to. The one above adopted, however, seems preferable, as it is analagous to that given for the throw of the crank, which is almost invariably taken as the radius of the circle described by the crank-pin.

The most convenient practical method of measuring the throw of an eccentric, when fixed on a shaft, is to measure the greatest and least distances of the edge of the disc from the circumference of the shaft, and to divide the difference between them by two. This will be readily seen from Fig. 11, in which *C* and *O* are the centers of the shaft and disc respectively; join *C*, *O*, and produce *C O* both ways to meet the circumference of the eccentric, then *E H* and *A B* are the distances to be measured.

Now $C H - C B = C O + O H - C B$;
but $O H - C B = O B - C B = C O$;
therefore $C H - C B = 2.C O$ = twice throw.
Also $C H - C B = E H - A B$ (by taking $C E$ or $C A$ from both).

Therefore $\frac{EH - AB}{2}$ = throw.

Thus suppose *E H* and *A B* were found to be 10½ in. and 2⅛ in., respectively, the throw will be $\frac{10\frac{1}{2} - 2\frac{1}{8}}{2}$ =4 3-16 in., or the stroke is 8⅜ in.

The eccentric revolves within the "eccentric strap," which is a hoop, usually of brass, which works in a recess formed in the rim of the eccentric disc. The eccentric strap is put on in halves, which are bolted together by bolts passing through two lugs on each side, as shown.

The "eccentric rod" is the rod which communicates the motion of the eccentric to the valve; one end is bolted to a boss cast upon one half of the eccentric strap, and the other, in this case, is in immediate connection with the end of the valve-rod.

The "valve-rod" is the rod which is attached to the valve itself; it passes steam tight through a gland and stuffing box at one end of the valve-chest, and in this case it also works in a guide at the other end.

FIG 3

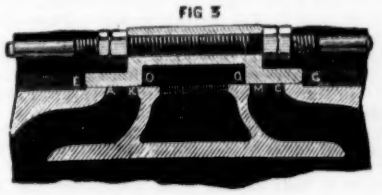
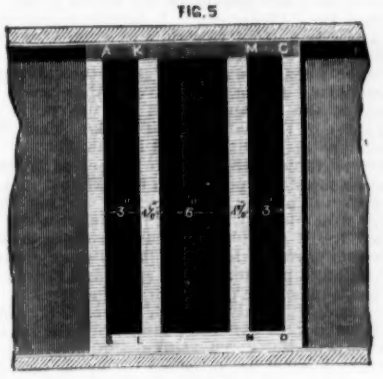


FIG. 5



We shall now describe Figs. 3, 4, 5, and 6, which illustrate an example of the ordinary slide-valve. Fig. 3 is a section of the valve and ports through the center

line of the cylinder; Fig. 4 is a section at right angles to this line through the exhaust port; Fig. 6 is a plan of the underside or face of the valve, which works

FIG 4.

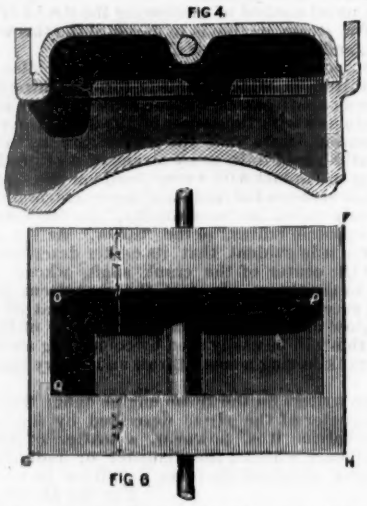


FIG 6

against the face of the cylinder and over the ports, a plan of which is shown in Fig. 5.

This ordinary form of slide-valve, which is usually of cast iron, may be described in general terms as a shallow box open at the bottom, and having outside a broad flange along the opposite edges, and a narrow one along the remaining two A hole is formed through the center of the back of the valve through which the valve-rod passes. The length of the rod which passes through and a little beyond each way is screwed; a pair of nuts are screwed on at each end against a boss at each end of the valve. These secure the valve to the rod, and afford an easy means of adjusting the position of the valve. The face of the valve is brought to a perfectly plane surface, so as to slide steam tight over the face of the cylinder, the sides of the valve casing, as in Fig. 4, forming guides to prevent lateral motion.

The valve here shown is one suitable for a pair of inverted, direct-acting, screw engines, 38 in. diameter and 2 ft. stroke. Fig. 3 shows the valve placed symmetrically over the ports or at half stroke. A reference to these figures will aid the reader in thoroughly mastering the following definitions.

"Stroke" or "travel" of the valve is the distance traveled by the valve between its extreme positions. When the valve-rod is in direct connection with the end of the eccentric rod, as in Figs. 1 and 2, the travel of the valve is manifestly equal to twice the throw of the eccentric; but when the valve-rod is moved by the eccentric through the intervention of levers, etc., its stroke is determined from their dimensions as well as the throw of the eccentric.

The edges *A B* and *C D* of the steam ports (Fig. 5) are called the "admission edges of the ports," because when the edges of the valve *E F*, *G H* (Fig. 6) have moved past them steam is admitted through the ports into the cylinder; for the same reason the edges *E F* and *G H* are called the "admission edges of the valve."

The edges *K L*, *M N*, of the steam ports are called the "exhaust edges of the ports," because when the edges *O P*, *Q R*, of the valve have moved past them a communication is opened between the steam ports and the exhaust space O P, R Q, of the valve, and thence to the atmosphere or condenser; for the same reason the edges *O P*, *Q R*, are called the "exhaust edges of the valve."

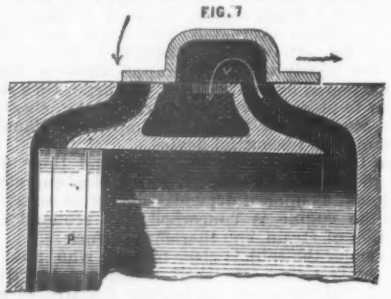
The broad flanges *E F*, *P O* and *Q R*, *H G*, are called the "faces" of the valve, and the amount of their projection beyond the admission edges of the ports, when the valve is at "half stroke," is called the "lap on the steam side," or simply the "lap" or "cover." In Fig. 3, *A E* or *C G* is the "lap."

"Lap on the exhaust side" or "inside lap" is the projection of the faces of the valve beyond the exhaust edges of the ports when the valve is at half stroke. In Fig. 3, *K O* or *Q M* is the inside lap. From Fig. 3 we see that the outside lap is equal to ½ (*E G*—*A C*), or half the difference between the length of the valve and the distance between the admission edges of the ports; that is, in this example, to ½ (18⅞—15¼)=1 13-16th in. We also see that the inside lap is equal to ½ (*K M*—*O Q*), or half the difference of the distances between the exhaust edges of the ports and the exhaust edges of the valve—that is to ½ (9¼—9⅛)—1-16th inch. When the valve at half stroke does not cover the exhaust edges of the ports the amount by which it fails to do so is called the "clearance." It may be considered as inside lap with a negative sign, and when a valve has it its amount is equal to half the difference of the distances between the exhaust edges of the valve and those of the ports. If the valve have neither inside lap nor clearance the exhaust edges of the ports coincide with those of the valve at half stroke Thus, in Fig. 3, *O* would coincide with *K*, and *Q* with *M*.

The "cylinder bars" are the narrow partitions which separate the steam ports from the exhaust port; they are shown in plan in Fig. 5, and in section in Fig. 3. In this example they are each 1⅝ inches wide.

Figs. 7, 8, 9 and 10, which are sections through the valve and ports on the center line of the cylinder, show four different positions of the valve and the corresponding positions of the piston during one stroke. *P* is the piston and *V* the valve in each figure. Fig. 7 shows the positions of the valve and piston when the latter is just commencing the down stroke. Suppose the valve is shown to have already opened the upper port a certain amount; this amount is called the "outside lead" or simply the "lead" of the valve, which may, therefore, be defined to be the amount the port is opened for the admission of steam at the commencement of each stroke. This figure also shows that the lower port is open to the exhaust, the amount of this opening at the beginning of a stroke is called "inside lead," and by comparing this with Fig. 10 it will be seen that the distance the valve has traveled past half stroke is equal

FIG. 7



to the sum of the outside lap and the outside lead, and that, therefore, we have

Inside lead = outside lap + outside lead — inside lap.

If the valve have clearance, we must have

Inside lead = outside lap + outside lead + clearance.

If it have neither inside lap nor clearance, we have

Inside lead = outside lap + outside lead.

FIG 8

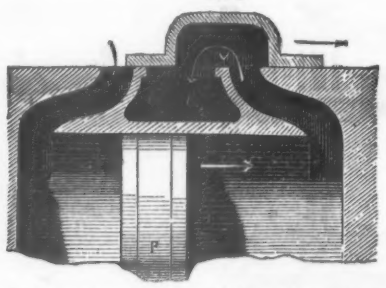


Fig. 8 shows the relative positions when the valve is at one extremity of its stroke, and has consequently given the greatest opening of the port for the admission of steam of which it is capable. This amount of opening is not necessarily equal to the width of the steam port itself, as we shall see presently.

FIG 9

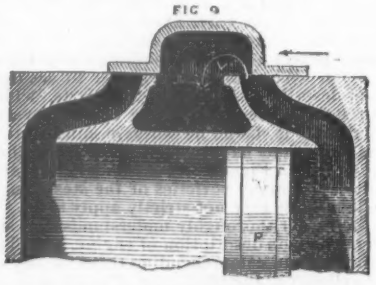


Fig. 9 shows the positions of the piston and valve when the latter is just cutting off the supply of steam for the down stroke; the lower steam port will be seen to be still open to the exhaust space.

FIG.10

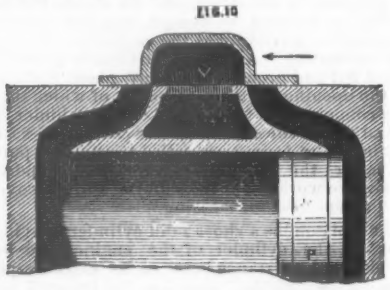


Fig. 10 shows the valve just opening the upper port to the exhaust. Comparing this with Fig. 9 it will be seen that if the valve have inside lap the steam is shut in above the piston, while the valve travels a distance equal to the sum of the outside and inside laps. If the valve have clearance, this distance will be equal to the difference between the outside lap and clearance, and if there be neither lap nor clearance, this distance will be simply the lap.

The same figure shows the lower port to be closed to the exhaust; if the valve have clearance, the port will not be yet closed, and if there be neither inside lap nor clearance the lower port will be just covered when the upper is just opening to the exhaust.

The next event is the valve just opening the lower port to steam, and when this takes place the piston will not have quite reached the bottom of its stroke, in consequence of the lead, as explained above. After this every event in the distribution of the steam by the valve for the upper stroke takes place in the same order as before, and so on for each revolution.

In our next paper we shall explain the several purposes which are effected by the lap, lead, etc.—*English Mechanic.*

—Contracts for the completion of the tower and middle locks of the Mississippi River Rapids Improvement were let at Keokuk on the 29th ult. Mr. Schwartz, of Keokuk, received the contract for the lower lock, at $103,000, and Wm. Johnson, of Fulton, N. Y., the contract for the middle lock, at $104,000.

Transmission through Pneumatic Tubes.*

The writer having been employed in designing the extension of a pneumatic dispatch line in which some heavy gradients were unavoidable, it became necessary to ascertain by calculation the steepest gradient that could be employed so as to obtain a sufficient carrying capacity in the new section of the line under given conditions of engine power and of length. Almost every text-book and paper on the velocity of gases in pipes gave a different formula, and the author therefore found it necessary to attempt to construct a convenient expression for the speeds of carriers of given weight and friction, under various conditions of pressure, gradients and dimensions of tube. The problem of a successful pneumatic system is simply this: To make a given quantity of air expand from one pressure to another in such a way as to return a fair equivalent of the work expended in compressing it. It is obviously impossible to regain the full equivalent of the work, because the compression is attended with the liberation of heat, which is dissipated and practically lost. Therefore, in designing a pneumatic system, the first thing is to contrive means of compressing the air as economically as possible; and, in the second place, to get back the available mechanical effect stored up in the compressed air, irrespectively of the work employed in compressing and examining it. The writer considers that small pneumatic tubes may be worked more profitably than large ones. The great convenience of and the practical facilities for working small letter-carrying tubes have been amply proved by the extensive systems already laid down in Paris, Berlin, London, and in other towns, as adjuncts to the telegraph services. Tubes of somewhat larger diameter would undoubtedly work satisfactorily. Even still larger tubes, of a moderate length, might also be found useful for a variety of special applications. But the author does not believe that a pneumatic line working through a long tunnel could, for passenger traffic, ever compete in point of economy with locomotive railways. A pneumatic railway is essentially a rope-railway. Its rope is elastic, it is true, but it is not light. Every yard run of it, in a tunnel large enough to carry passengers, would weigh more than ¼ cwt. And it is a rope, too, which has to be moved against considerable friction, and in being compressed and moved wastes power by its liberation of heat. In a pneumatic tunnel, such as that proposed between England and France, in order to move a goods train of 250 tons through at the rate of twenty-five miles an hour, it would be necessary to employ simultaneously a pressure of 1½ lbs. per square inch at one end, and a vacuum of 1½ lbs. per square inch at the other. The mechanical effect obtained of these combined—pressure and vacuum—would be consumed as follows:

In accelerating the air . .	29	millions of foot pounds.
In accelerating the train . .	12	
By friction of the air . .	5721	
By friction of the train . .	330	

The resistance of the air, therefore, upon the walls of the tunnel would alone amount to 93 per cent. of the total mechanical effect employable for the transmission; while the really useful work would be only about 5¼ per cent. of it. And to compress and exhaust the air to supply these items of expenditure of mechanical effect, engines would have to exert over 2,000 horse power at each end during the transmission, even on the supposition that the blowing machinery returned an equivalent of mechanical effect such as has never yet been obtained. This would not be an economical way of burning coals.

*Abstract of a paper read at the Liverpool meeting of the British Association, by Robert Sabine.

—The following is a copy of an act passed by the Pennsylvania Legislature, the object of which is to put a stop to the practice of jumping on cars while in motion. It is entitled, "An act to prevent trespassing upon railroad cars:"

SECTION 1. *Be it enacted, etc.*, That any person willfully entering in or upon any railroad car, whether the same be passenger, freight, coal or other car, contrary to the rules of the corporation owning the same, without paying fare, shall forfeit and pay a penalty of not less than one dollar nor more than five dollars, which shall be paid to the treasurer of the school district in which such offense is committed, for the use of said school district; and any constable or police officer having knowledge of the violation of this act may forthwith arrest the offender; and the magistrate shall proceed to determine the matter in issue, and if he shall convict the person so charged he shall proceed to pronounce the forfeiture against the person convicted; and if the person convicted refuse to satisfy such forfeiture immediately, then the magistrate shall commit the offender to jail for a period not exceeding ten days: *Provided*, That nothing herein contained shall be held to prevent the prosecution and conviction of any person who may falsely personate another with a view of riding in any passenger car without payment of fare.

—The Des Moines *Register* of May 3 gives the following account of the nerve of a fireman on the Des Moines Valley road: "As the Valley train was approaching the city from the south at 4 p. m., a day or two ago, a little child was observed on the track. The engineer at once whistled down brakes and reversed the engine, but had it not been for the presence of mind and bravery of Dick Lenahan, the fireman, the child must have been run over, for the train could not be stopped before it reached the place where the child was. Dick jumped from the cab to the front of the locomotive, and from thence to the cow-catcher in a twinkling, and leaning over, brushed her off the track just as the locomotive reached her, thus saving her life. Well done, Dick Lenahan!"